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VOLUME LI.—1885.

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In the matter of Letters Patent granted to Dr. Leo Gans of Frankfort on Main, and Dr. Meinhard Hoffmann, of Mainkur, near Frankfort on Main, in the Empire of Germany, Chemists, for an invention for "The manufacture of new colour-yielding products and of colouring matters therefrom," Dated 5th January, 1884, No. 816.

NOTICE IS HEREBY GIVEN THAT the said Dr. Leo Gans and Dr. Meinhard Hoffmann have applied under Sections 18 to 21 of the Patents, &c., Act, 1883, and Rules 48 to 56 of the Rules made thereunder, for leave to amend the complete Specification of the said invention.

A copy of the said complete Specification as proposed to be amended can be inspected at the Patent Office, and full particulars of the proposed amendment were published in the Official Journal of the Patent Office issued on the 16th day of December, 1884, No. 100, page 1356.

Any persons intending to oppose such application must leave particulars in writing of their objections to the proposed amendment at the Patent Office, 25, Southampton Buildings, Chancery Lane, London, W.C., within one calendar month from the date hereof.

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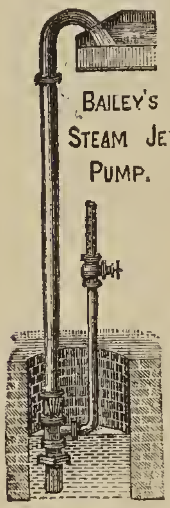
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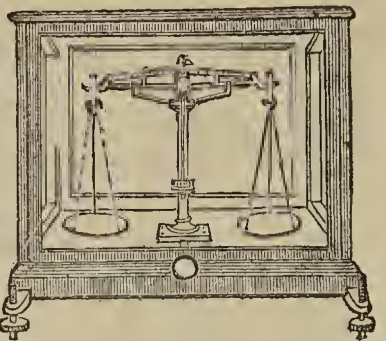

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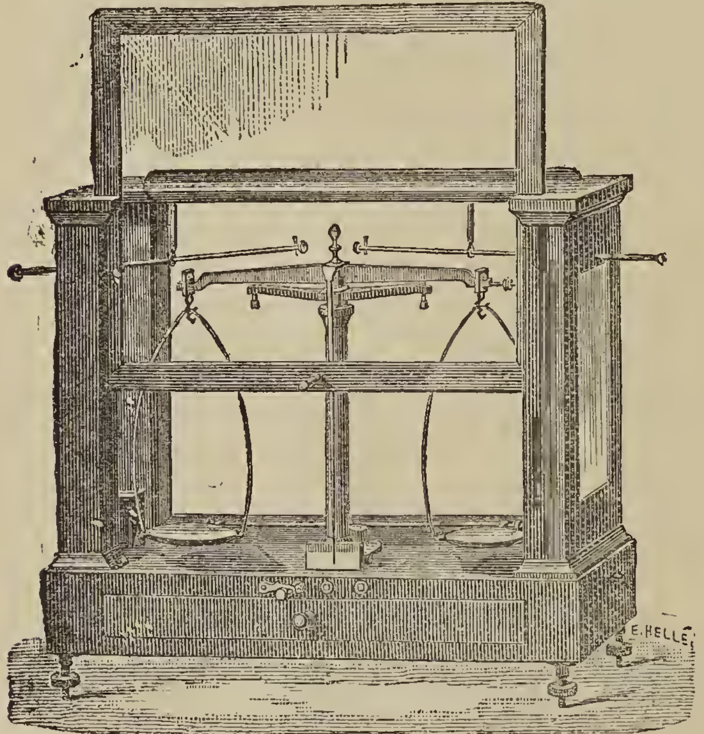

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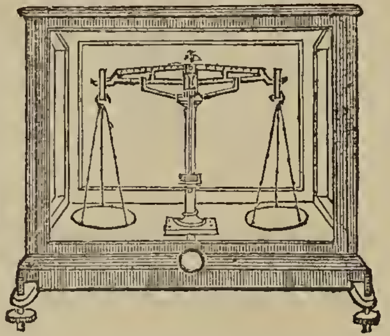

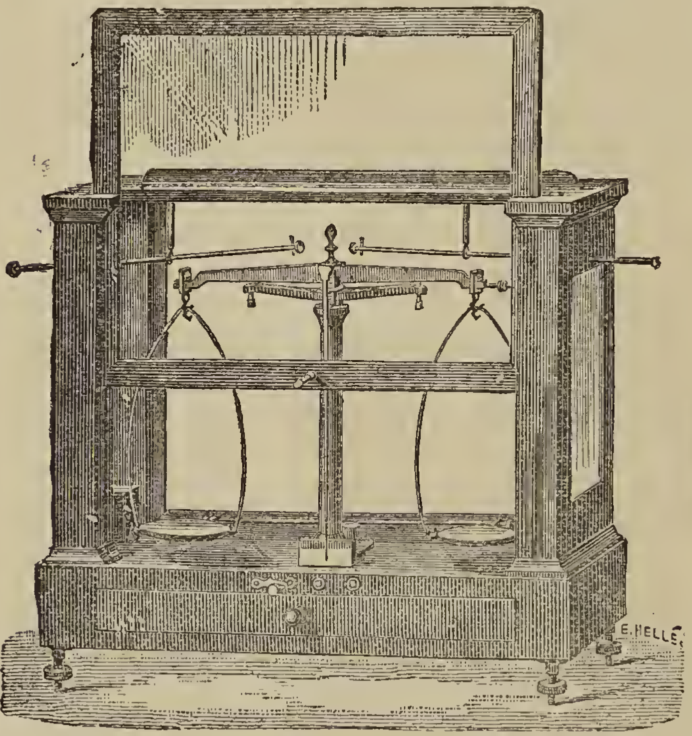
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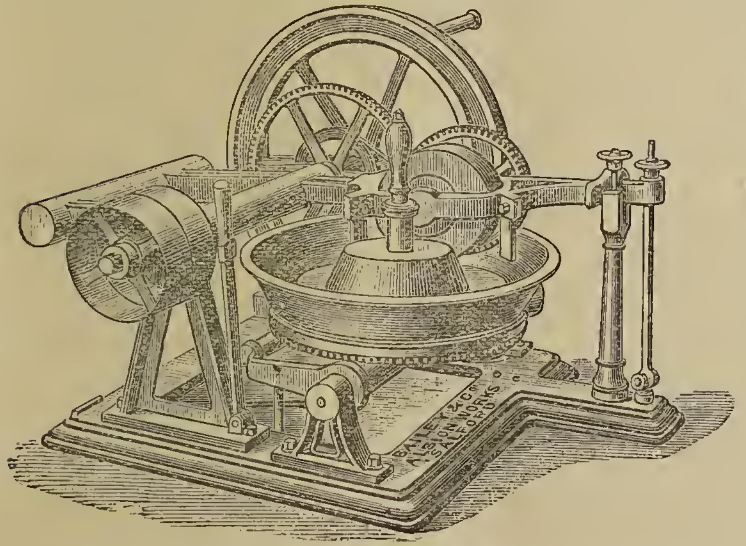

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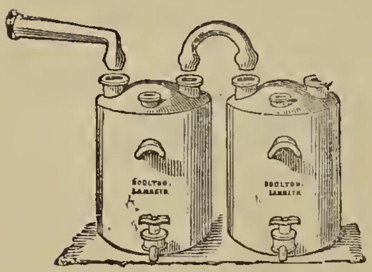

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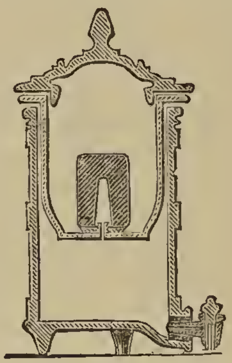

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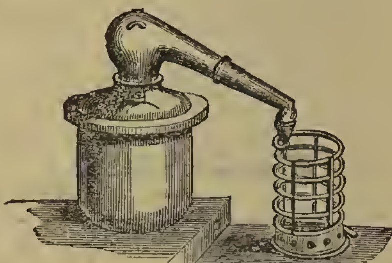

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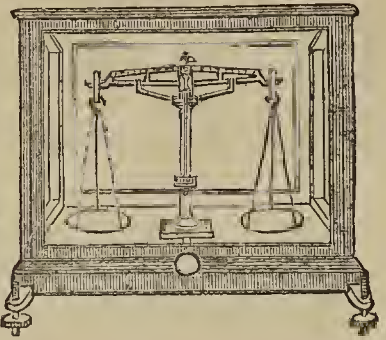

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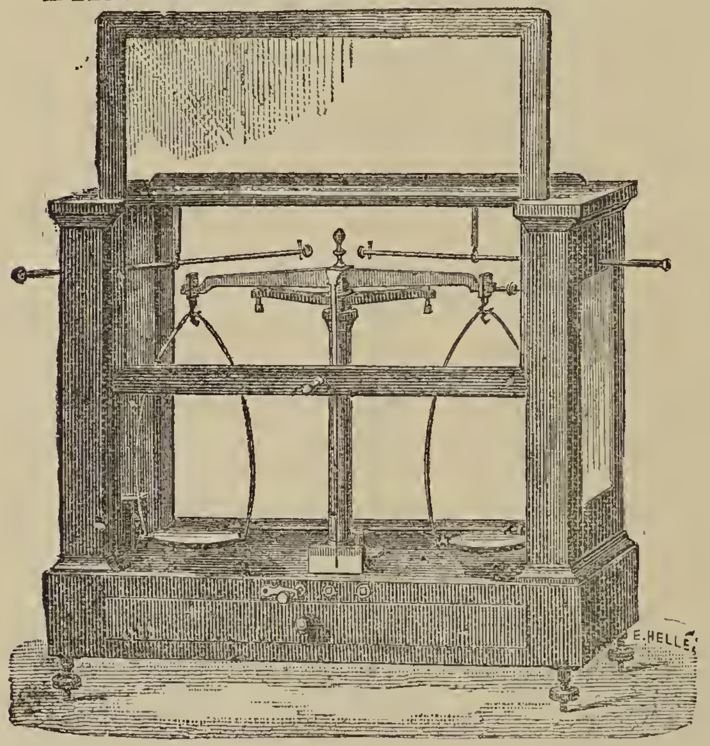

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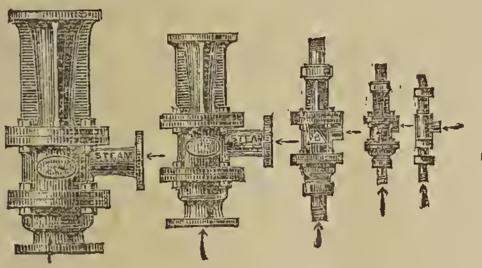

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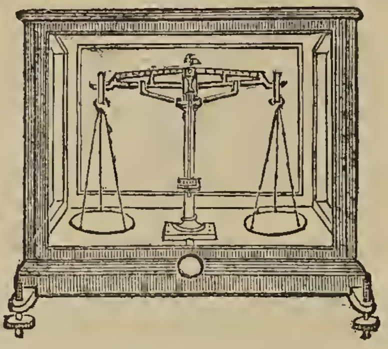

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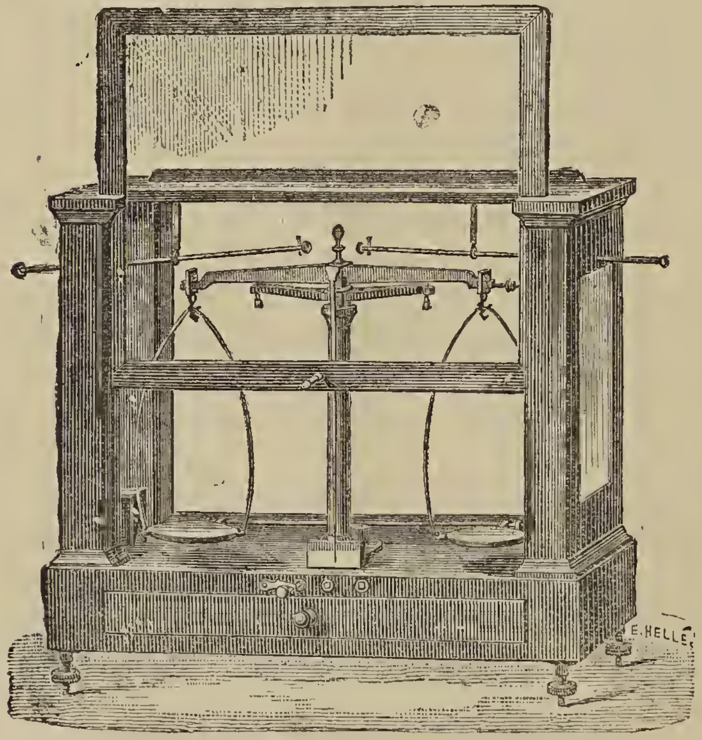

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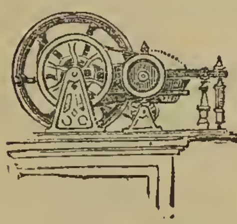

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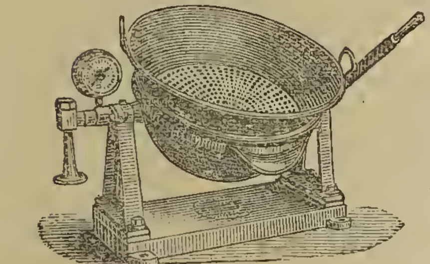

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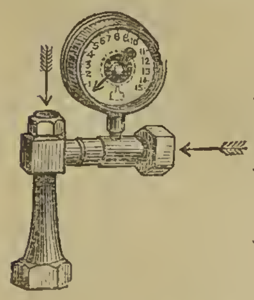

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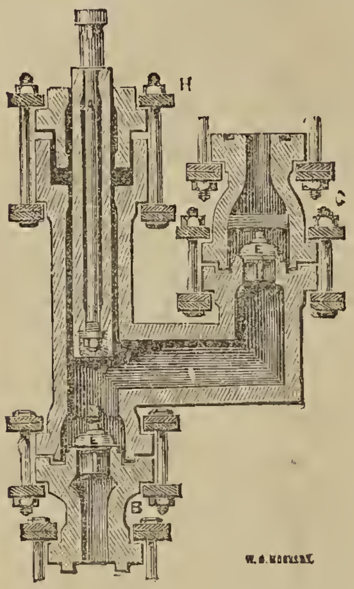

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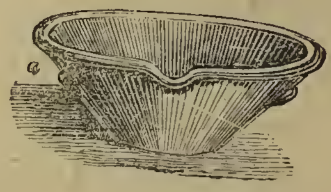

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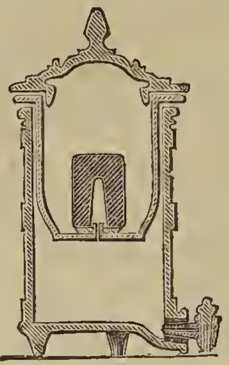

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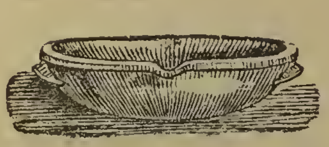

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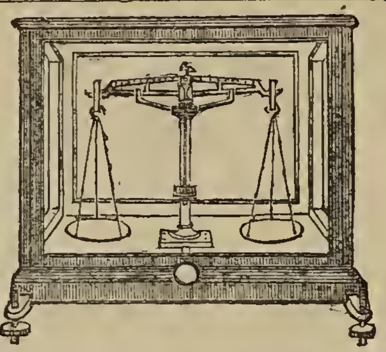

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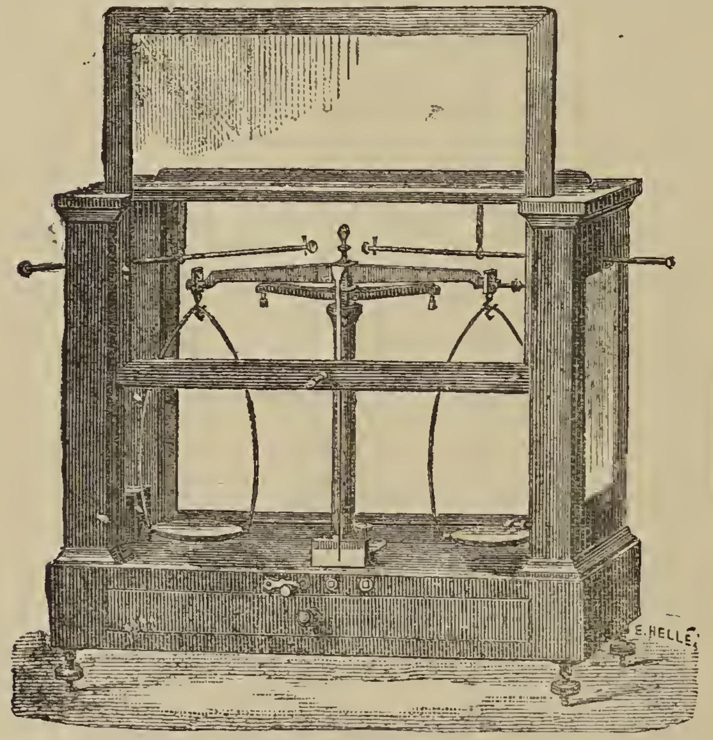

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IN THE MATTER of the Application for Letters Patent made by Charles Denton Abel, of No. 28, Southampton Buildings, Chancery Lane, in the County of Middlesex, Consulting Engineer and Patent Agent, for "The production of violet and blue colouring matters of the rosaniline series by treating aromatic amines with alkalised amido-derivatives of benzoyl chloride and of benzophenone," communicated from abroad by Farbwerke vormals Meister, Lucius, and Brüning, of Hoechst am Maine, in the German Empire, Dated 15th March, 1884, No. 4961.

NOTICE IS HEREBY GIVEN, that the said Charles Denton Abel has applied, under Sections 18 to 21 of the Patents, &c., Act, 1883, and Rules 48 to 56 of the Rules made thereunder, for leave to amend the Complete Specification of the said invention. A copy of the said Complete Specification, as proposed to be amended, can be inspected at the Patent Office, and full particulars of the proposed amendment were published in the Official Journal of the Patent Office issued on the 27th January, 1885, No. 112, pages 257 and 258.

Any person intending to oppose such application must leave particulars in writing of their objections to the proposed amendment at the Patent Office, 25, Southampton Buildings, Chancery Lane, London, W.C., within one calendar month from the date thereof.

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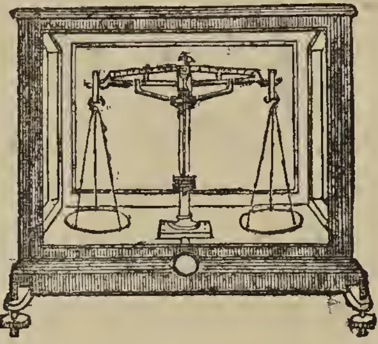

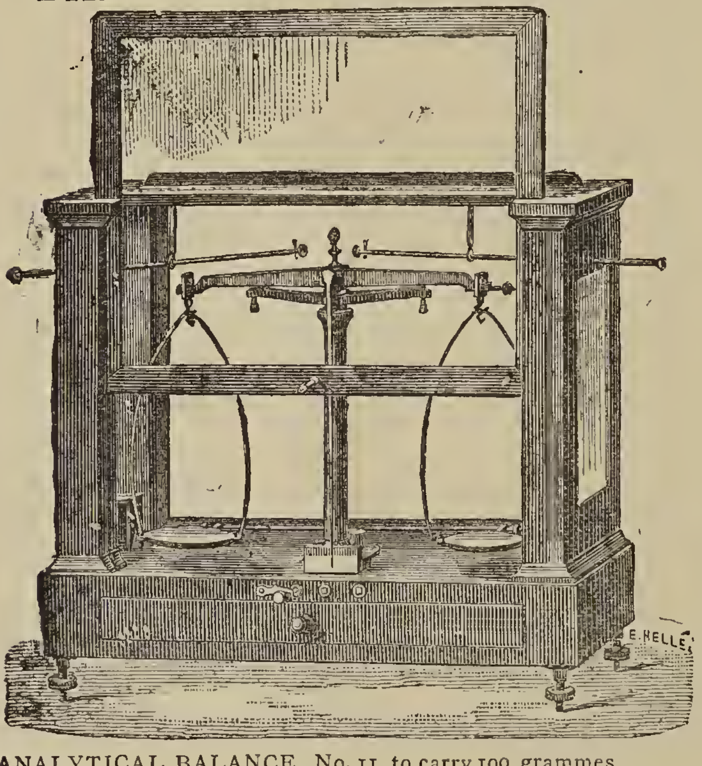
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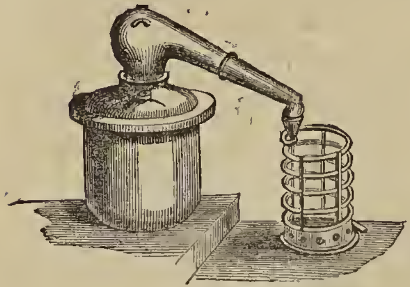

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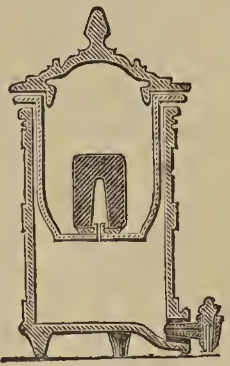

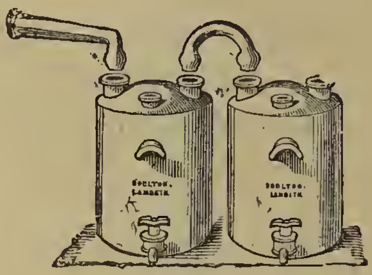

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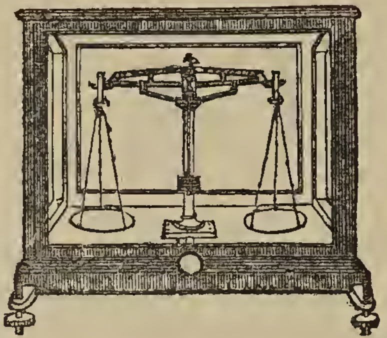

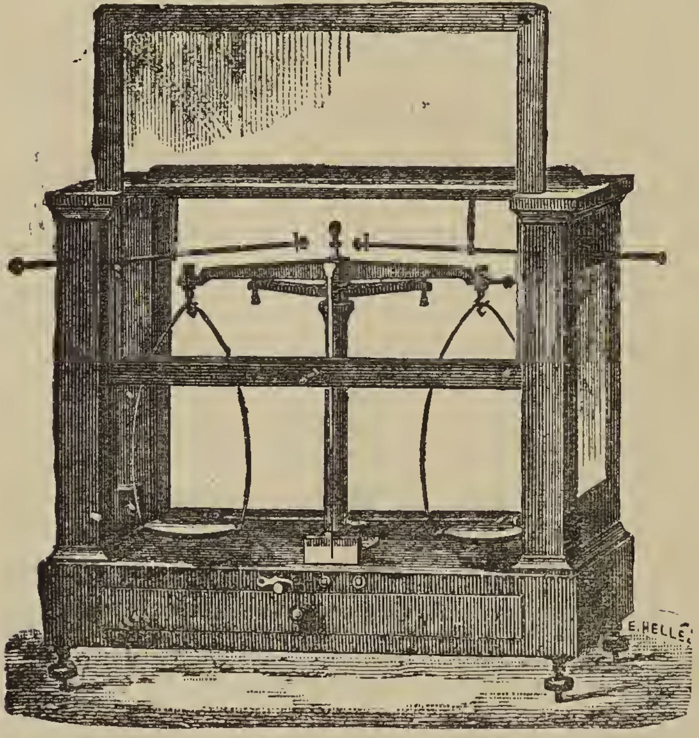

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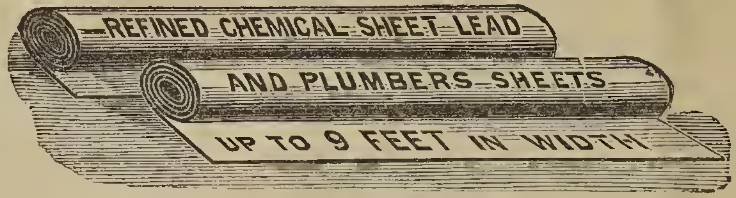

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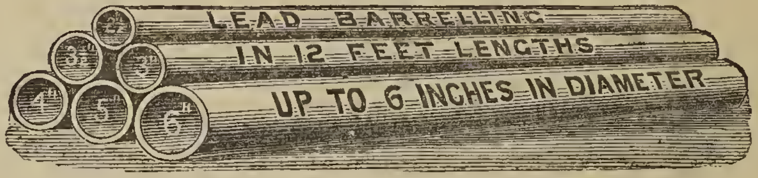

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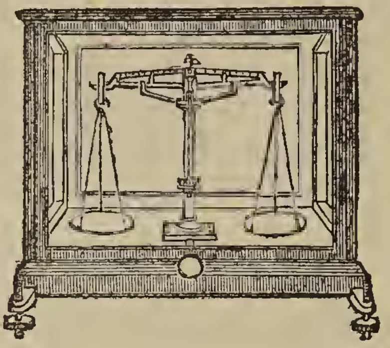

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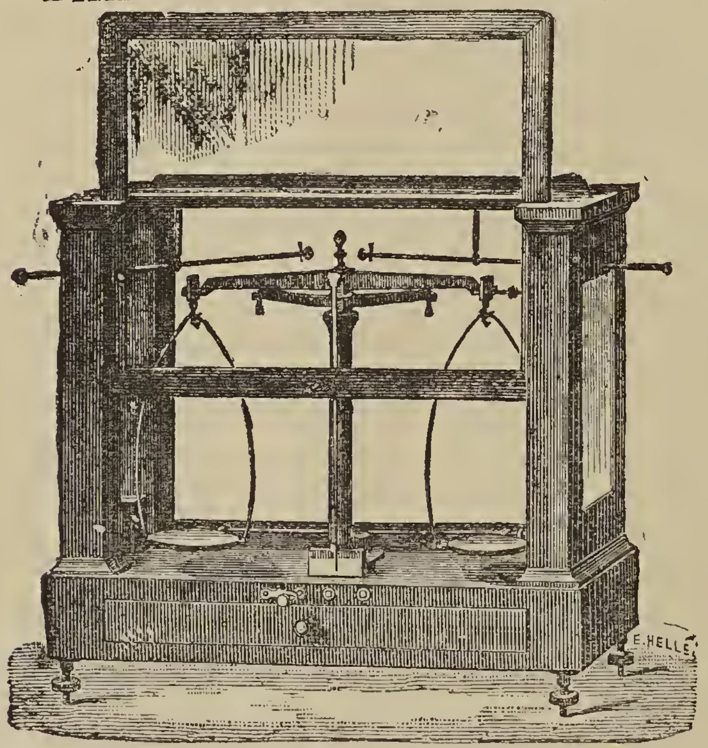

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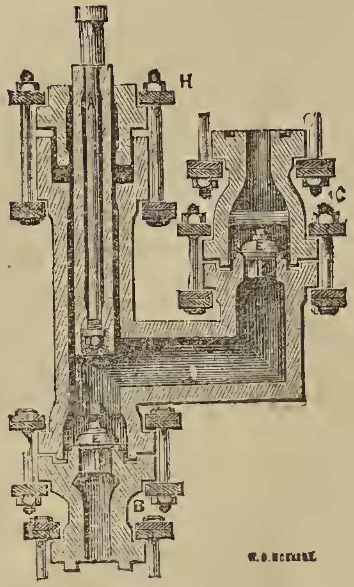

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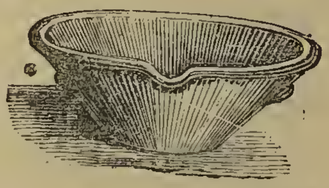

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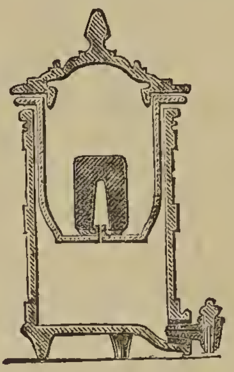

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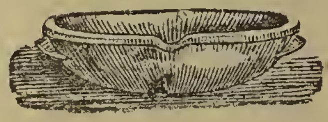

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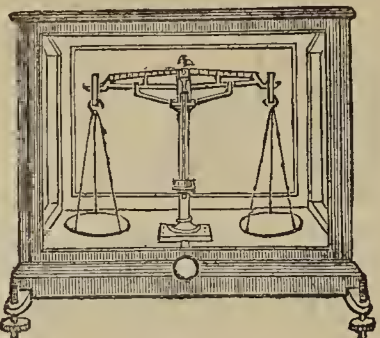

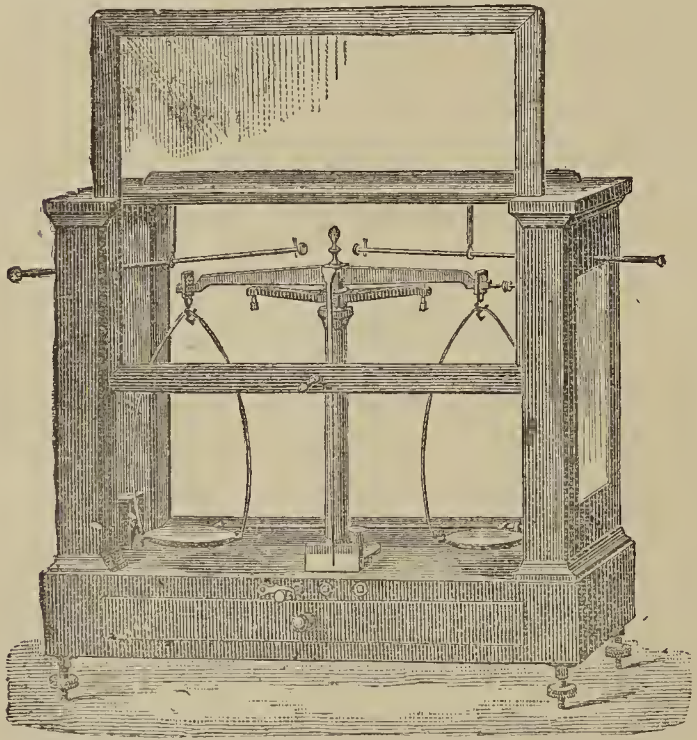

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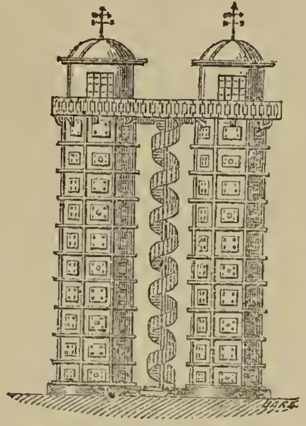

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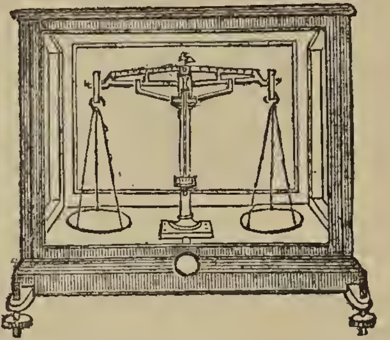

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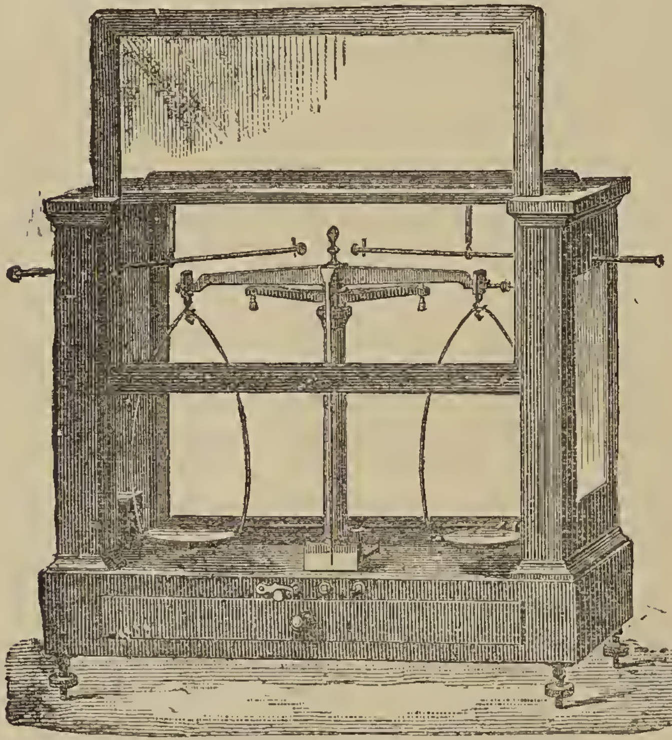

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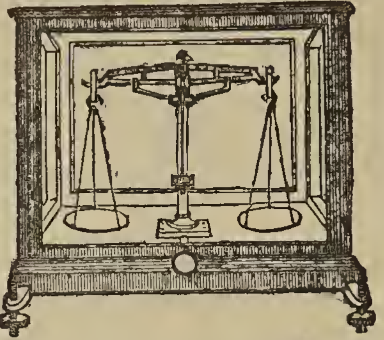

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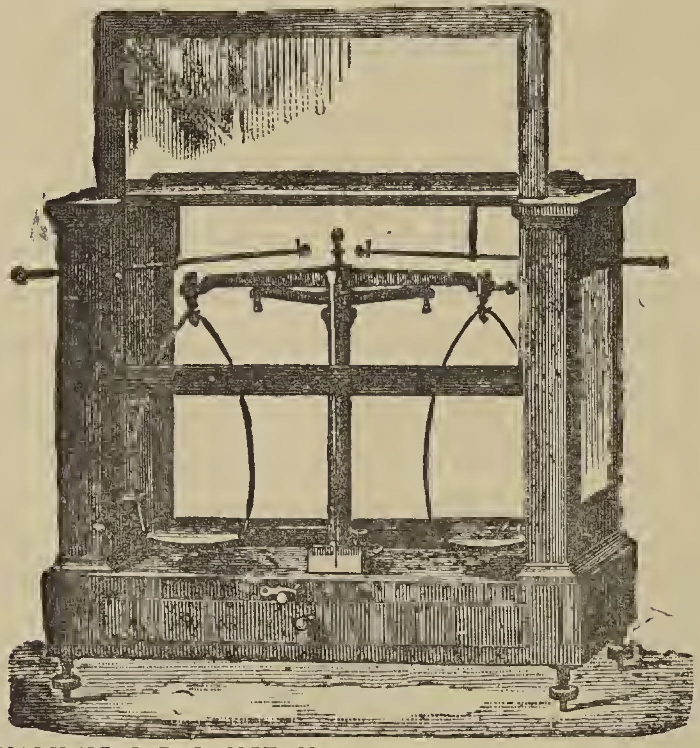

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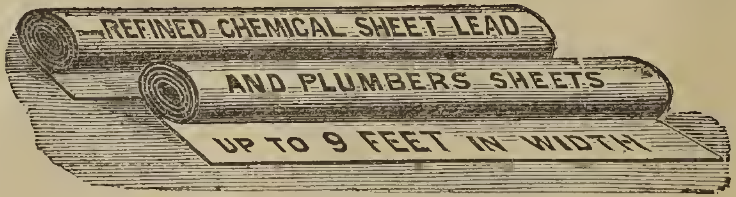

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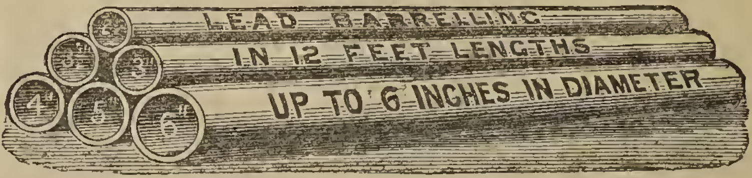

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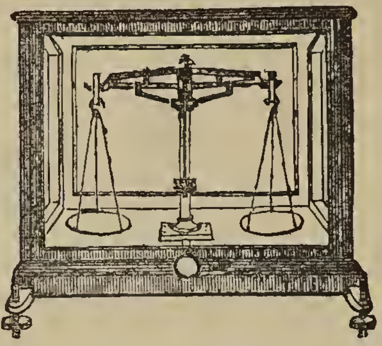

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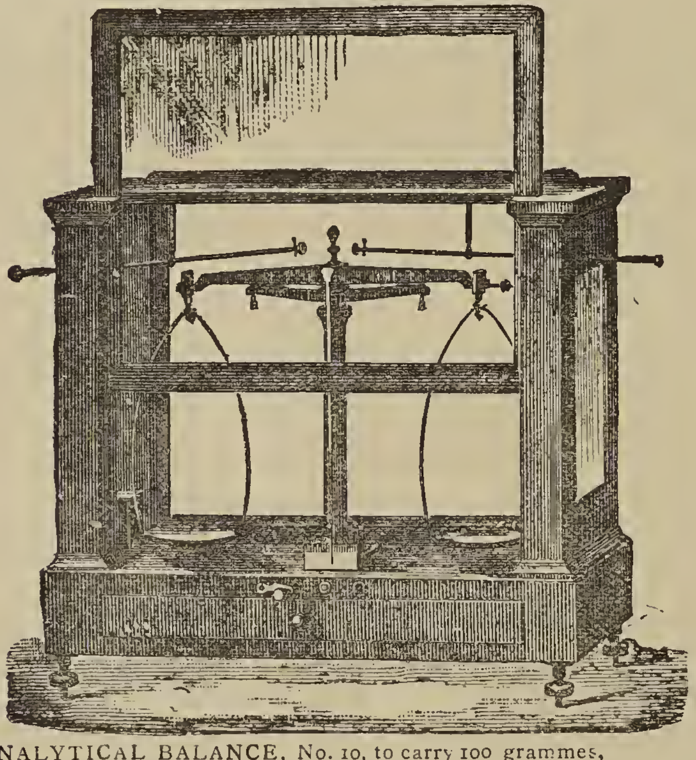

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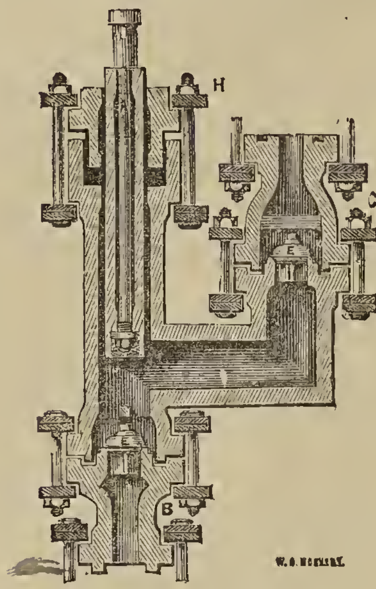

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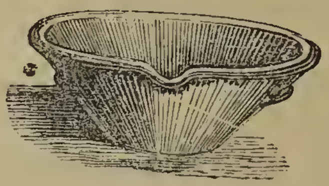

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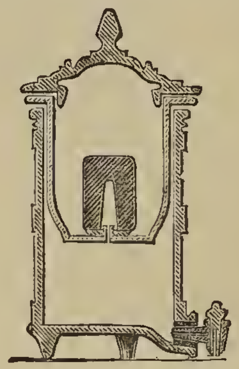

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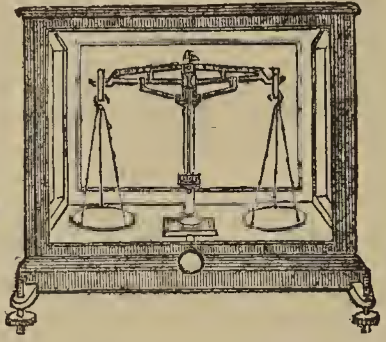

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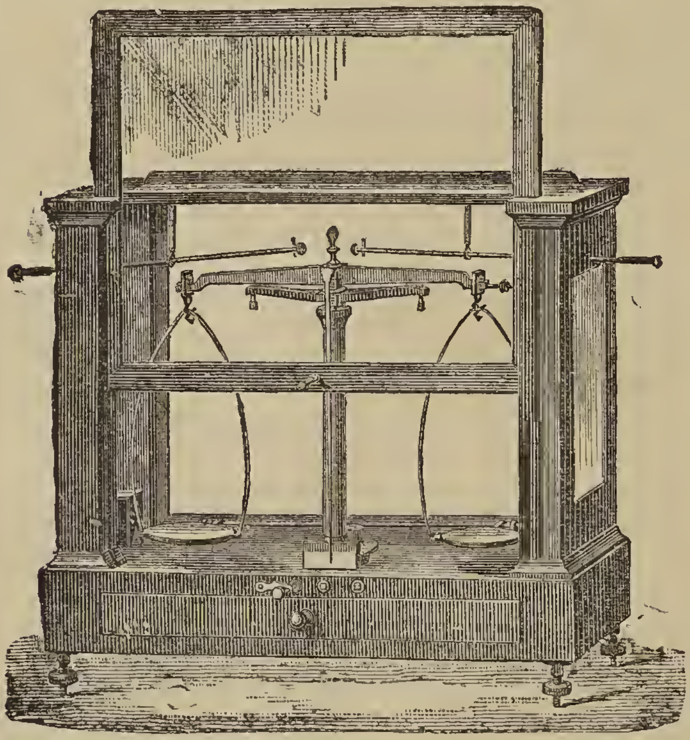

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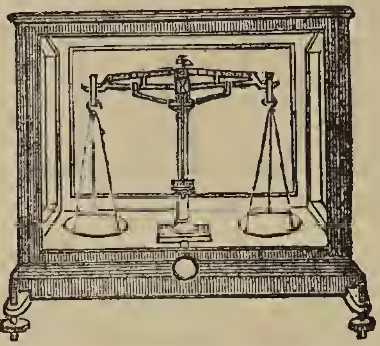

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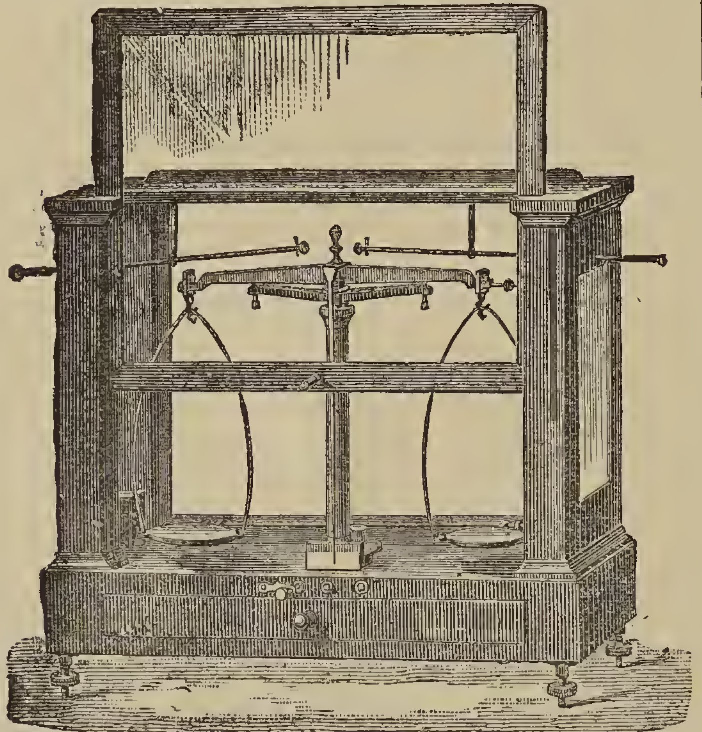

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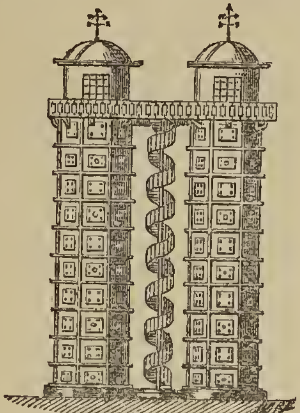

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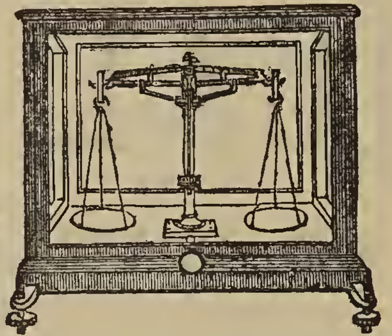

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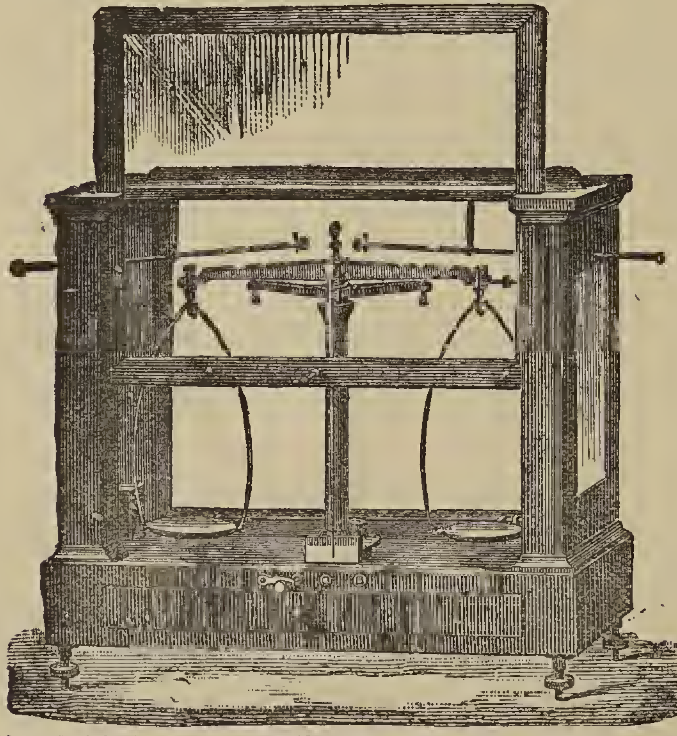

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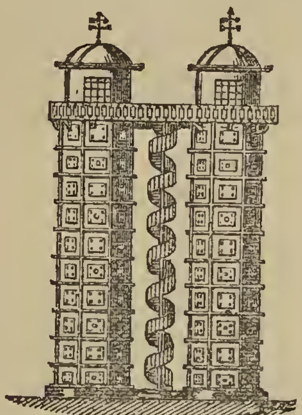

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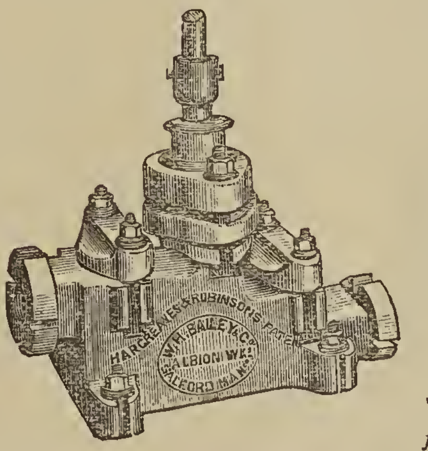

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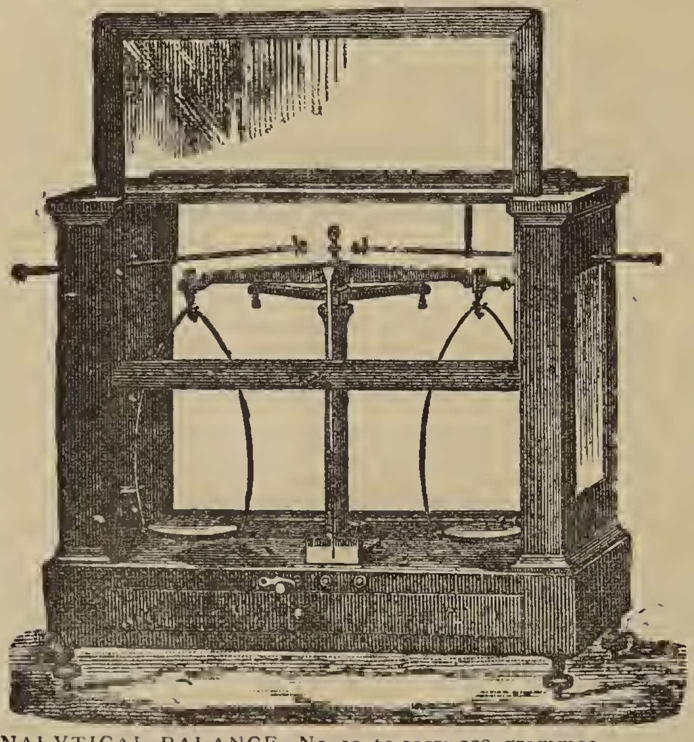

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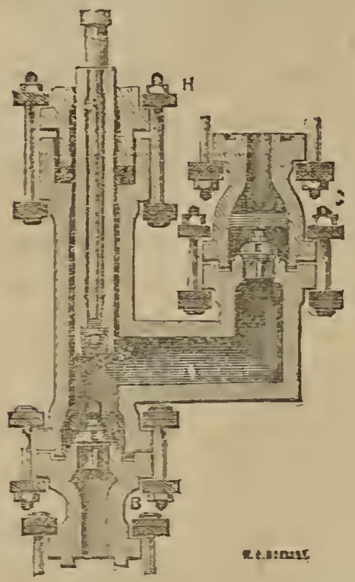

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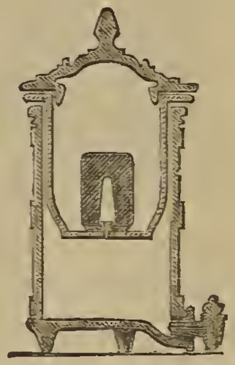

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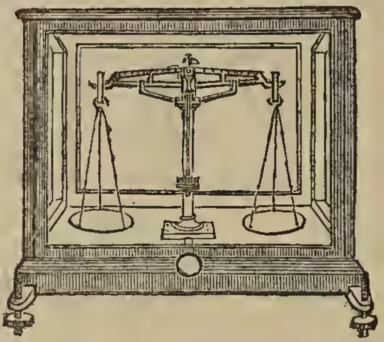

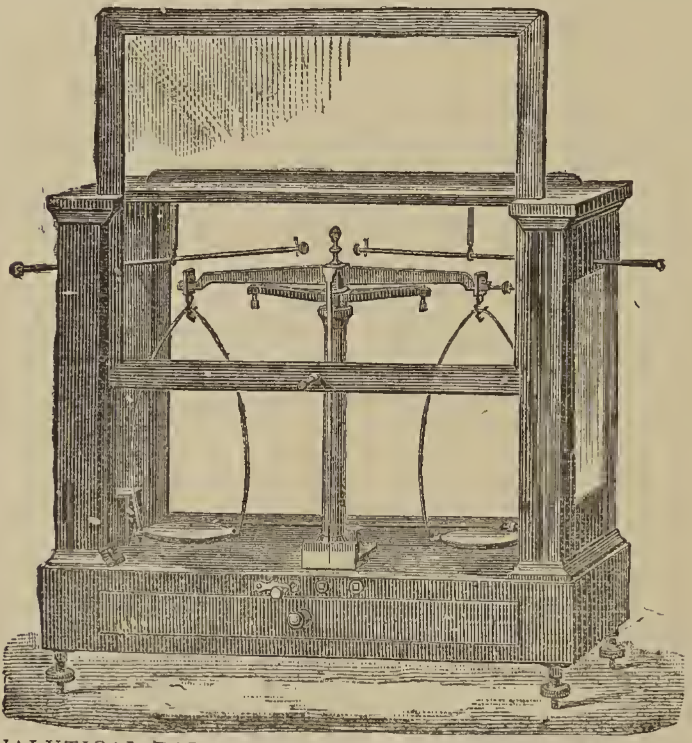

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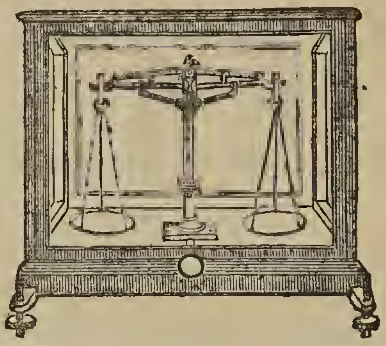

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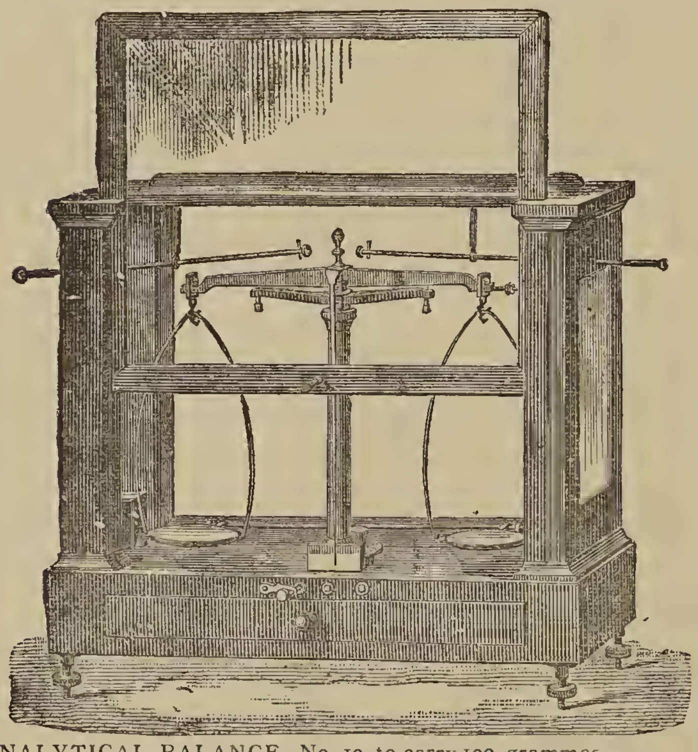

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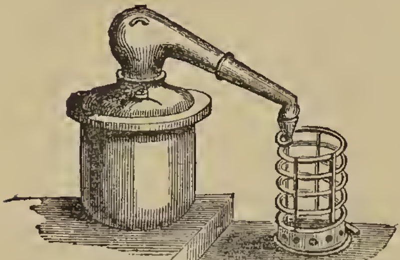

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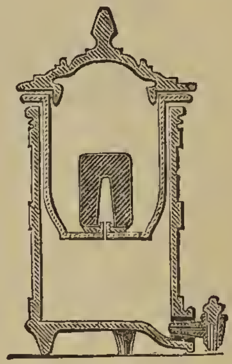

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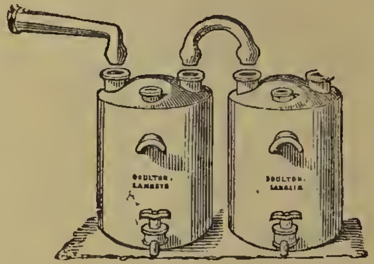

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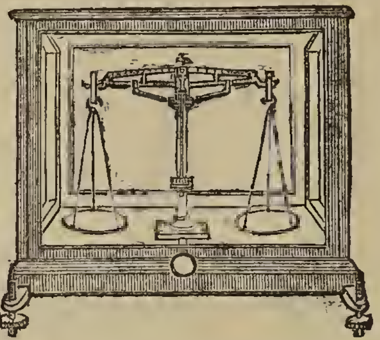

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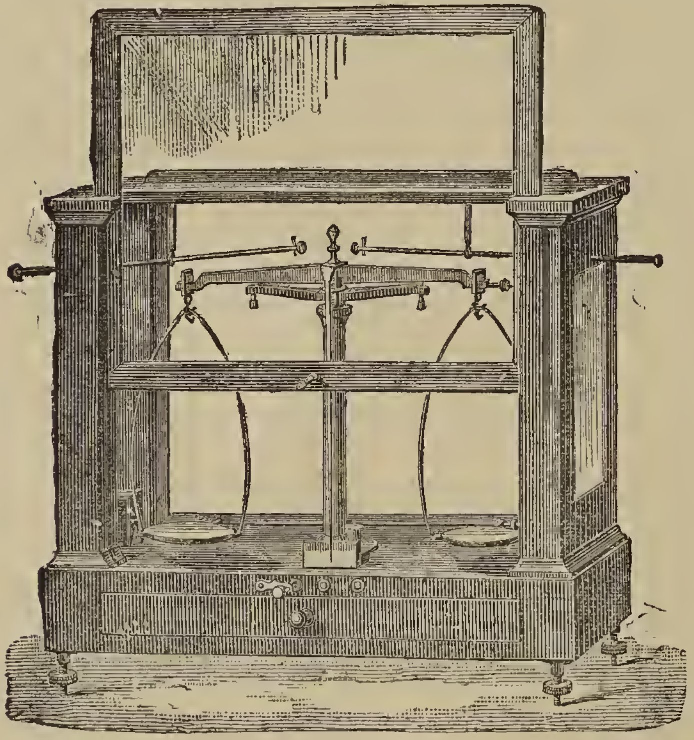

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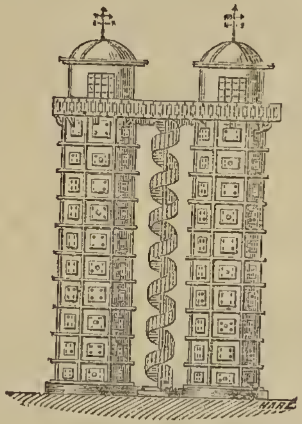

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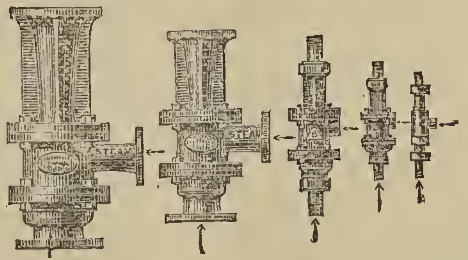

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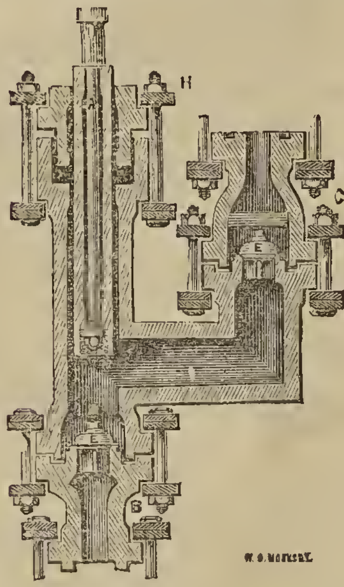

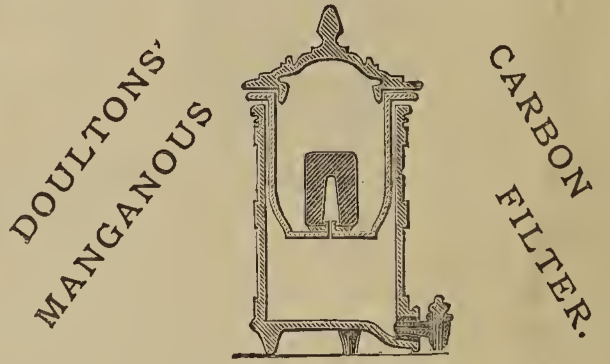

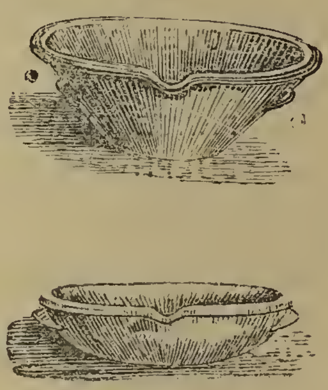

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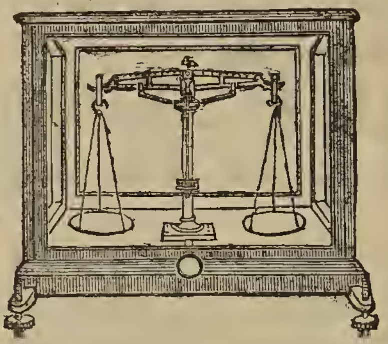

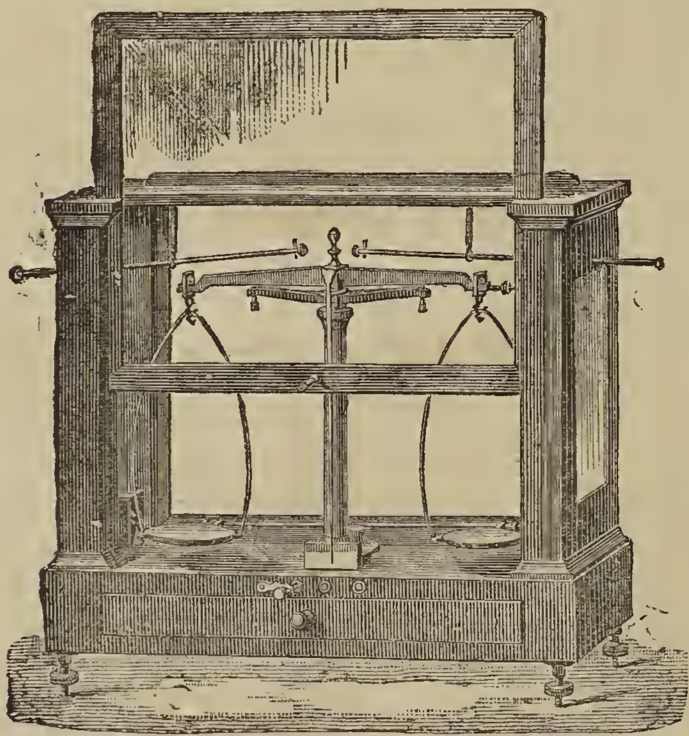

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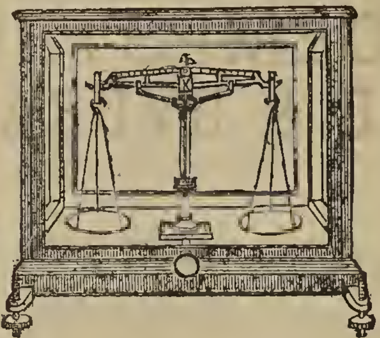

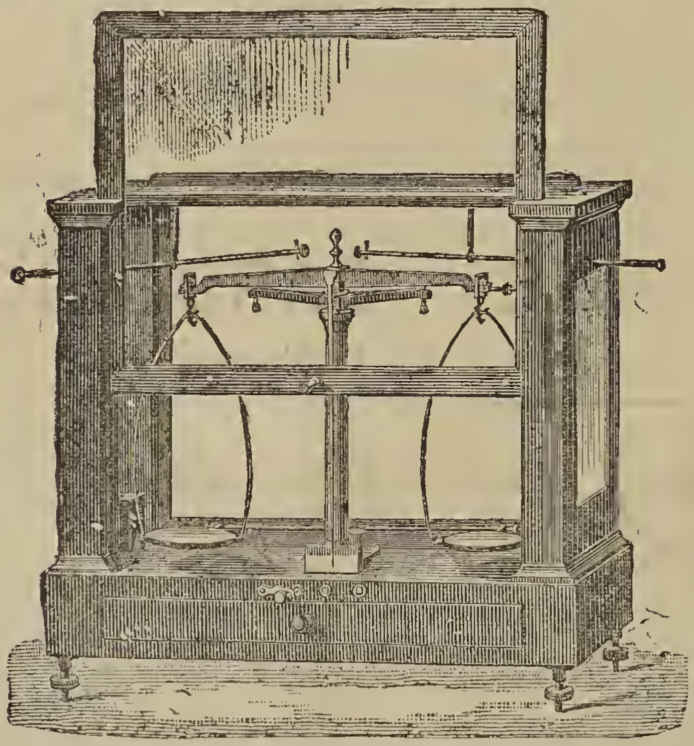

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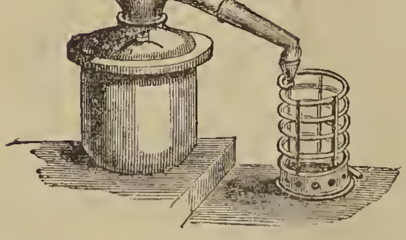

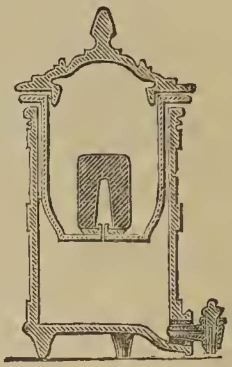

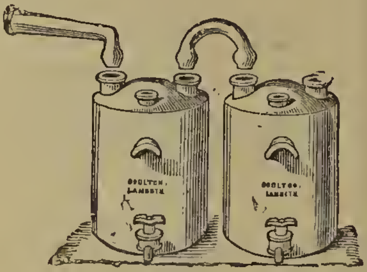

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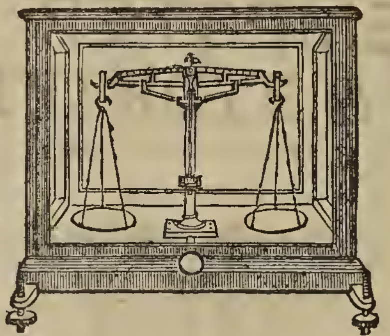

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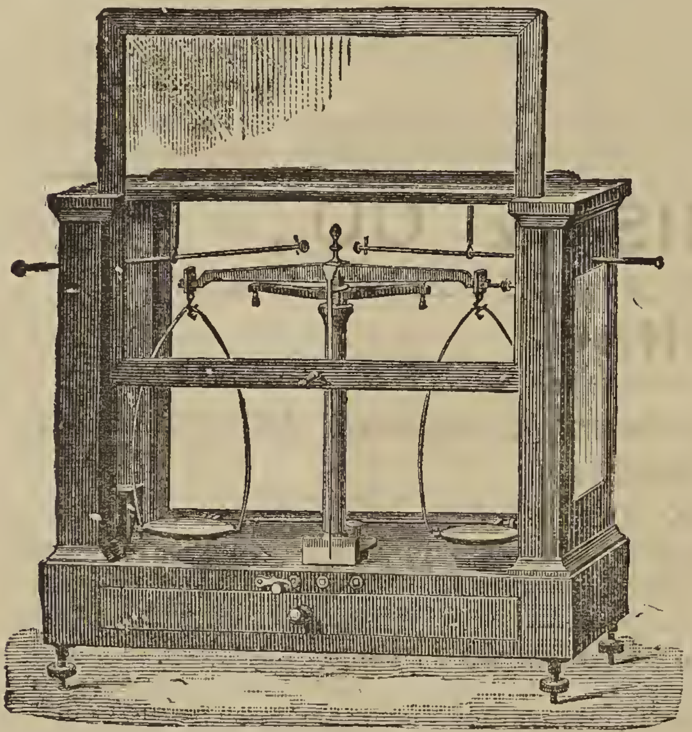

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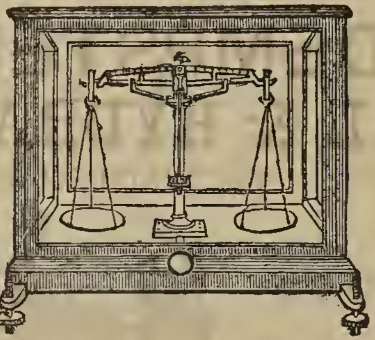

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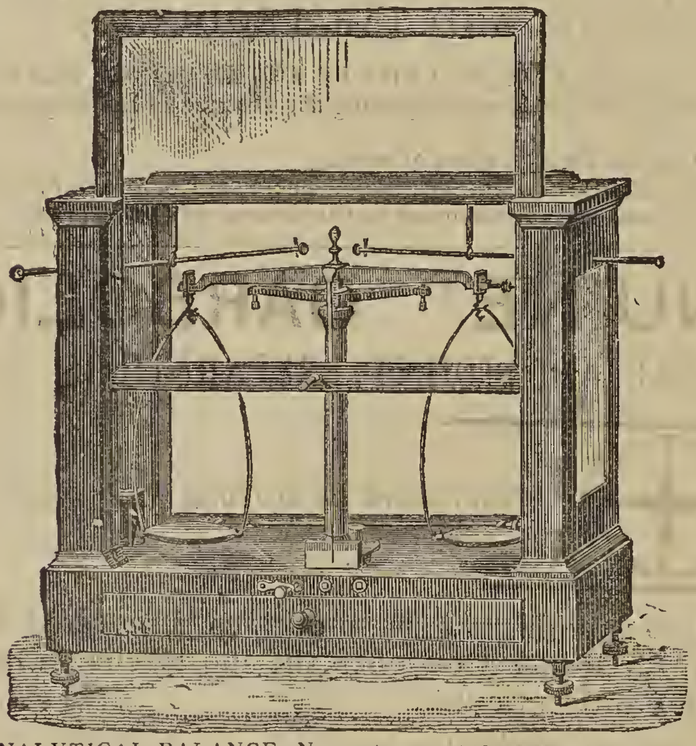

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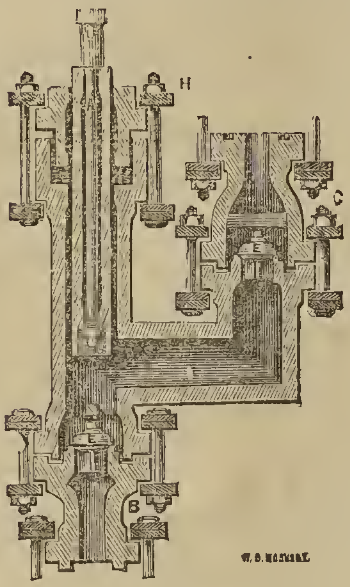

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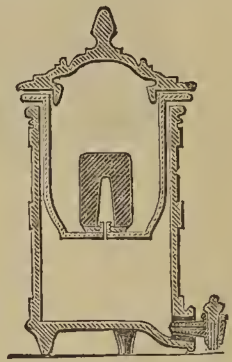

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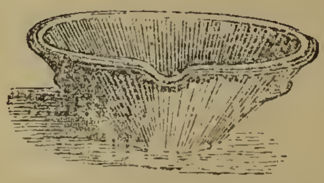

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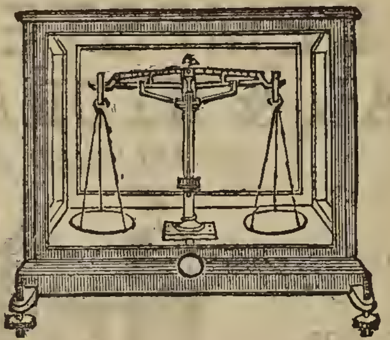

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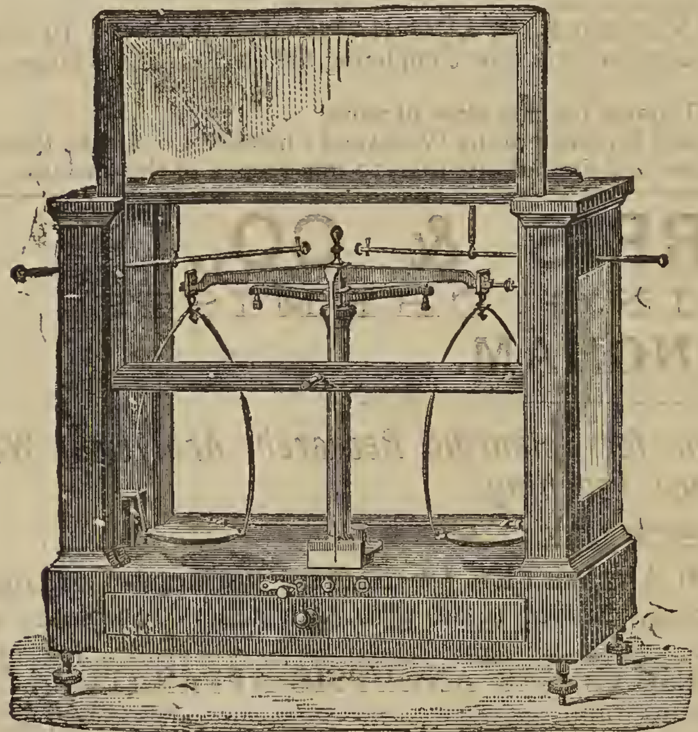

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THE FUSION, CASTING, DEPHOSPHORISING, AND PLATING OF IRIDIUM, TOGETHER WITH A BIBLIOGRAPHY OF THE SUBJECT.

By NELSON W. PERRY, E.M.

In the following article the author has endeavoured to give in concise form most of the important data now known in regard to the occurrence, properties, uses, &c., of the mineral iridosmine; also to describe Holland's method of successful fusion, Dudley's method of electroplating, and to enumerate a few of the new applications rendered possible by these new discoveries.

For the benefit of those caring to delve more deeply into the history of iridium and its salts and alloys than has been possible for the author in these pages, a bibliography of the subject has been attached. Although the author has been at considerable pains to make this as complete as possible, he realises that it is not perfect, but believes it to be the most complete of any yet prepared.

As to the fusion and mechanical manipulation of the fused iridium, the whole story is told, there being no secrets withheld. In regard to the electroplating, it is regretted that more cannot be told at present, but the reasons are obvious and imperative.

We are greatly indebted to Mr. Holland and Professor Dudley for unrestricted opportunities for informing ourselves, and for their careful revision and approval of our paper.

This metal has been known to chemists for some years, although the public has had but little experience with it; even mining prospectors are, for the most part, unfamiliar with its appearance and properties.

In the year 1803, Smithson Tennant, while investigating the metallic residue which remained when platinum ores were dissolved in aqua regia, thought he had discovered a new metal. Descotils, Fourcroy, and Vauquelin were at the same time examining similar residues, and they also came to the conclusion that a peculiar metal was present; but, however, in 1804, Tennant announced to the scientific world that he had proved the presence of two new metals in these platinum residues, to one of which he gave the name of *iridium*, on account of the iridescence of some of its compounds; and to the other, the name of *osmium*, because of the peculiar odour which its volatile oxide possessed.

Iridium is found in considerable quantities in the platinum ores, in the form of platin-iridium, which is an alloy of platinum and iridium, and osm-iridium or iridosmine, which is an alloy of osmium and iridium. The platin-iridium occurs in grains, and sometimes in small cubes with rounded edges. The iridosmine is usually found in the form of flat, irregular grains, and occasionally in hexagonal prisms.

The geographical distribution of this metal is quite wide; it is found in California, Oregon, Russia, East India, Borneo, South America, Canada, and Australia, and in small quantities in France, Germany, and Spain.

As we find iridosmine, or the so-called native iridium, it is associated with numerous rare metals; viz.: osmium, platinum, rhodium, ruthenium, and palladium, and also with iron and copper.

Iridium possesses a white lustre resembling that of steel. In the cold it is quite brittle, but at a white heat it is somewhat malleable. It is one of the heaviest of metals, having a specific gravity of 22·38.

The principal sources are Statoust, Kyschtimsk, and Katharinenberg in the Ural Mountains, the latter place producing about 200 ounces per annum. California comes second in production.

Iridosmine has never been found *in situ*, but is obtained in the alluvial deposits and beaches, where it has been collected by a natural concentration, as is our placer gold and platinum.

Though California now stands second in production to Russia it is probable that, as the demand increases and the mineral is more carefully sought for, she will take first rank, Oregon, Washington, and the western coast of British America being close competitors. The great sources in these regions being certain stretches of beach sands which have from time to time been worked in a desultory way for gold.

Nearly all the gold regions have yielded more or less of this mineral. In California it is more abundant in the northern counties than in the middle or southern, and is the most abundant in the beach sands of the northern coast near Port Orford. According to Dr. Torrey, for a year or two after the establishment of the U.S. Assay Office at New York the proportion of iridosmine in the gold from California did not exceed half-an-ounce to 1,000 000 dollars. The quantity afterwards increased until the average was seven or eight ounces to the million of gold, showing great fluctuations, due, doubtless, to the opening of new diggings and abandonment of others.

These beach sands derive their gold as well as their iridosmine doubtless from the erosion of the neighbouring bluffs by the waves. No veins have as yet been discovered in these bluffs, but it is supposed that the metals are disseminated throughout their mass.

The mineral varies in hardness according to the varying percentages of platinum and osmium present, being usually placed between 6 and 7 in the scale of hardness, though occasionally reaching nearly 8.

As indicated, its composition, and therefore its specific gravity, also vary, the former averaging: iridium, 70 per cent to 75 per cent; osmium 18 per cent to 20 per cent, with varying amounts of platinum, ruthenium, palladium, rubidium, and frequently traces of iron and copper.

The general character of the iridosmine varies, too, with the locality. In colour it varies from a steel grey to blue; that obtained from Russia being usually richer in platinum, sometimes containing as high as 33 per cent Pt, and softer, while the California product is remarkably free from platinum, is heavier, denser, bluer, and harder, consequently the most desirable for the penmaker's use.

It is, practically, unattacked by either acids or alkalies. In aqua regia it is slightly soluble—perceptible, however, only when the mineral is in a very fine state of subdivision.

When highly heated in oxygen, or in the air, the osmium becomes oxidised and volatilised as osmic acid, which is characterised by its exceedingly offensive and penetrating odour, somewhat resembling garlic, and also by its exceedingly poisonous and irritating qualities. It is related of Dr. Ste.-Claire Deville that he completely lost his sight for some six months by getting some of the fumes into his eyes.

The pure iridium also takes up oxygen at a red heat, but parts with it again at a temperature of about 1000° C.

Iridium is one of the most difficultly fusible of all metals, as will be seen from the following partially successful attempts to fuse it. In Gmelin's "Handbook of Chemistry," vol. 6, we find the results of some of these experiments. "Vauquelin fused it in very small quantity only, on charcoal ignited in a stream of oxygen, and obtained a somewhat ductile globule." This could not have been pure iridium if the globule was ductile, as he states. "Children fused it by his galvanic battery into a white, strongly lustrous, brittle, and still somewhat porous globule of specific gravity 18·68. This globule probably contained platinum (Berzelius). One grm. of iridium, heated on charcoal before Döbler's oxy-hydrogen blowpipe, fuses into a bright globule, which, however, appears to absorb gas, since, on solidifying, it throws out excrescences, and cavities are formed in its interior."

Platinum, which melts at a much lower temperature than iridium, was first fused by Dr. Hare, of Philadelphia, the inventor of the oxy-hydrogen blowpipe. He succeeded in melting about two pounds (971 grms.) at one time. He was also the first to melt iridium by this means.

As was before stated, the iridium which these old chemists claimed to have melted must have been impure, containing metals of lower melting-points; since one says he "obtained a somewhat ductile globule," and another found the specific gravity to be 18·68, when it is well known that pure iridium, in the cold, is not in the least ductile or malleable, and its specific gravity is 22·38. Alloys of platinum, with a small percentage of iridium, can be comparatively easily melted by the oxy-hydrogen blowpipe.

In a late determination, Violle estimates the melting-point of pure iridium at 1950° C., and platinum at 1750° C.

A few years ago MM. Deville and Debray succeeded in modifying Dr. Hare's blowpipe to such an extent as to obtain more satisfactory results, and in 1870 they prepared bars for the International Metrical System Convention, of 10 per cent iridium and 90 per cent platinum; and they successfully melted, in one charge, over 400 pounds of this alloy. This work was carried out under the superintendence of Mr. Geo. Matthey, of the firm of Johnson, Matthey, and Co., of London. This alloy is largely in use for making platinum dishes, stills, and crucibles, as the iridium renders the platinum much stiffer and harder, and consequently more durable than the pure metal.

Iridosmine does not form artificial alloys with either platinum, gold, tin, iron, nickel, cobalt, or silver, though it appears that the pure iridium does so with platinum. See Matthey's alloy. If zinc be heated with iridosmine *in the presence of ammonium chloride*, it seems to dissolve the iridosmine with great activity and evolution of heat. If now this combination of zinc and iridium be treated with H_2SO_4 the zinc is dissolved, leaving the iridium in the finest state of subdivision. This is practically the best method of disintegrating the mineral to render it more docile to solvents.

It seems strange that nearly all authorities up to within a few years have credited iridium with the property of alloying with gold. This it does neither in nature nor in art. As before intimated, on account of its high specific gravity, it remains with the gold in placer washings, from which it is with difficulty separated. This placer gold, therefore, when melted up into ingots, since it does not form an alloy with iridium, incorporates in its mass the grains of the latter, greatly impairing its value both for minting and jeweller's purposes. It becomes in this way a great nuisance to the mints, as the sharp edges of the grains cut and ruin the rolls and dies, and produce flaws in the work of the jeweller.

The Russian Government is the greatest sufferer on this account, as the gold obtained from the Ural Mountains is rich in iridosmine, which must be separated at great expense before it can be coined. Formerly the Government used to sell this iridosmine, but, finding that it was bought up by unscrupulous parties and used again for the adulteration of gold, it now not only *buys* iridosmine to make it an object to the miners to keep it *out* of the gold, but refuses, or has refused, absolutely to sell any. There has therefore, accumulated at the Russian mints large quantities of the metal, which they hold merely for their own protection, daring not to sell at prices the inferior stuff would bring for fear of its improper use.

Mr. Holland also finds it absolutely necessary, when working up his gold sweeps, to bring the gold into solution and filter it, this being the only way of getting it free from iridium, which, even in the smallest quantity, and in the finest state of subdivision, fails to alloy, and renders the metal unfit for pens. In the mints the iridosmine is concentrated in the bottom of the crucible, the pure gold being decanted from above, and the dregs are then treated with aqua regia to recover the remaining gold.

It has, however, the property of being readily soldered to gold, ordinary hard silver solder being that most used.

The chief application of iridosmine in the arts has been the pointing of gold pens, iridosmine being the so-called diamond point of the pen manufacturers, which consists simply of a small grain of iridosmine which has been selected for the purpose and soldered to the tip of the pen. These points are selected by first removing from the ore, by means of a magnet, the magnetic oxide of iron which always accompanies it, and then dissolving out, by means of acids, the other impurities which may be present; the ore is then washed with water, dried, and sifted in order to remove the fine dust, and the sifted ore is then ready for the selection of points. This is done by an operator, who rolls the grains of iridium around with a needle point, examining them under a magnifying glass, and selecting those which are solid, compact, and of the proper size, colour, and shape. These points are usually selected in three grades, small, medium, and large, depending upon the size of the pen for which they are intended to be used. The grain of iridium having been soldered on to the end of the pen, it is sawed in two (which makes the two nibs of the pen), and ground up in the proper shape.

A more recent application in the same direction is to the point of the McKinnon pen, which is tipped with a circle of solid iridosmine or phospho-iridium. These tips being non-corrodable, very hard yet non-abrasive, and, though infusible and not forming alloys, yet capable of being readily soldered to gold, silver, copper, brass, &c., have added much to the penmaker's art. But suitable grains are rare, constituting but about 10 per cent of that brought to market. While the latter cost but 2 dollars to 6 dollars per ounce in Russia, the selected grains are worth 100 dollars and upward here. Platin-iridium is unsuited for this purpose, being too soft. One ounce selected iridosmine contains from 3000 to 6000 grains. Of this the penmakers of the United States use from 20 to 30 ounces annually, which is equivalent to from 200 to 300 ounces of the crude article. A good iridium or "diamond-pointed" pen will last upwards of 20 years' constant use.

Fig. 1.

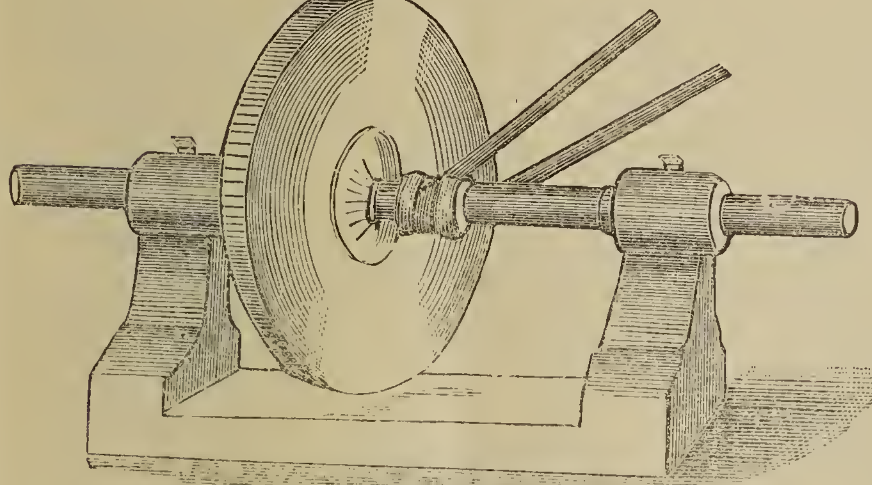
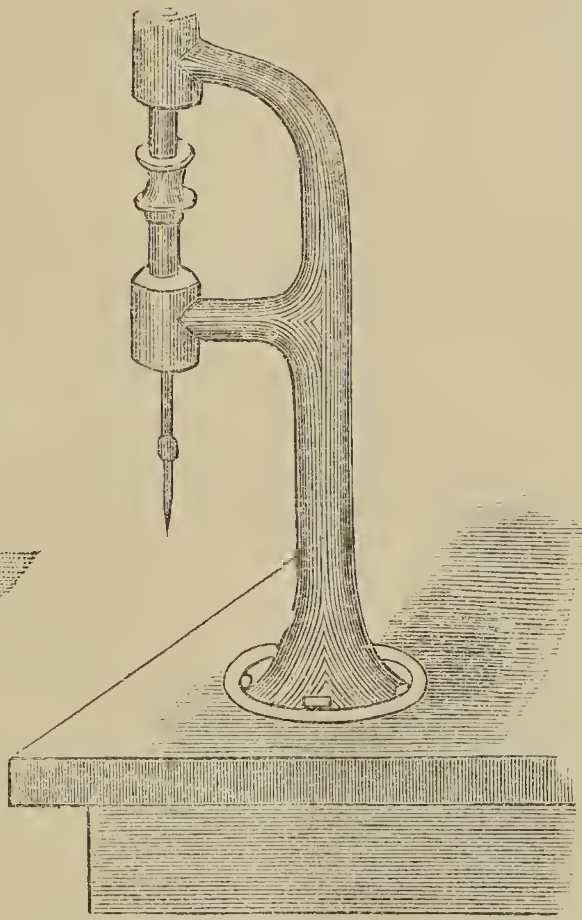


Fig. 2.



Another use for iridium, in the form of oxide, is to produce an intense and permanent black enamel in porcelain. In fact, it may be substituted in most cases where platinum black is applicable.

It occludes hydrogen, as does platinum, and when precipitated in alcohol will ignite dry paper.

When we have mentioned the application of Mathey's alloy (iridium 10 per cent, platinum 90 per cent) to the vents of heavy ordnance, and for standards of weights and measures, we have about completed the enumeration of the uses heretofore made of iridium in the arts. Messrs. Johnson, Matthey, and Co., of London, exhibited at Paris, in 1867, one vent that had fired 3000 rounds from a Whitworth cannon without appreciable wear.

The Fusion of Iridium.

As we have already seen, the uses of iridium in the arts has been confined almost entirely to that very small portion of the product which by nature has occurred in suitably large grains. Doubtless over 80 per cent of all the iridosmine found has been put to no use whatever. It has either been thrown away as valueless or stored up, as is the case in the Russian Mint, to prevent its improper use. It is not surprising that in the case of a mineral possessing such remarkable qualities as does this iridosmine, many attempts should be made to fuse it, and thus to make its application in the arts wider, and thus to utilise this large waste product of a by-product, for iridosmine has never been systematically mined as such, but is a by-product, and a very unwelcome one, too, in the metallurgy of gold and platinum. But it so persistently baffled all attempts in this direction up the present time that the thoughtful metallurgist or experimenter began to consider that he was in somewhat the same predicament as the alchemist of old who sought for a universal solvent—if he found it, what vessel could hold it? And if such a vessel could be found, it was proof that his object was not yet attained, for there would still remain one substance that his solvent would not affect. Without rehearsing the many fruitless endeavours to accomplish the much desired result, let us take up the thread that has led to the most complete and satisfactory solution of the problem.

Mr. G. W. Sheppard, a gold pen manufacturer, of Cincinnati, appreciating the desirability of accomplishing the fusion of iridium, commenced an elaborate series of experiments with that object in view, in the year 1842 or 1843. He employed every method that his ingenuity could suggest, including the oxyhydrogen blowpipe and the electric current, but died in 1862, after nearly twenty years' constant experimenting, apparently no nearer the goal than when he commenced. But it seems that he builded better than he knew, for by his zeal he sowed the seeds that have since matured to ripe fruition. He had as an *employé* a young man, who afterwards became his partner and finally his successor, Mr. John Holland, who throughout these years shared with him the labours and disappointments of his fruitless experiments.

On the death of Mr. Sheppard, Mr. Holland succeeded to his business, and also fell heir to considerable of his enthusiasm, and also to a very large stock of information as to how iridium could *not* be fused.

He continued the line of experiment with varying degrees of assiduity and discouragement until the year 1868 or 1869, when, with the view of setting other experimenters to work, and seeing if the thing were possible, he offered one thousand dollars, both in the United States and in France, to anyone who would fuse for him one ounce troy of iridium. No one being able to claim the reward, he would doubtless have abandoned all further attempts had not two events occurred shortly afterward.

He took the contract to supply the iridium tips for the McKinnon Stylographic Pen—then a new patent which required an iridium point drilled in the centre, for which only the larger grains were suitable. The demand for the pen so far exceeded his anticipation that he found it utterly impossible to fulfil his contract, and begged the company to cancel it. This they refused to do, and threatened to bring suit for breach of contract. This meant financial ruin to him, and the dim vision of fused iridium once more loomed up as the only genius that could avert it, so he went to work again with renewed energy.

FIG. 3.

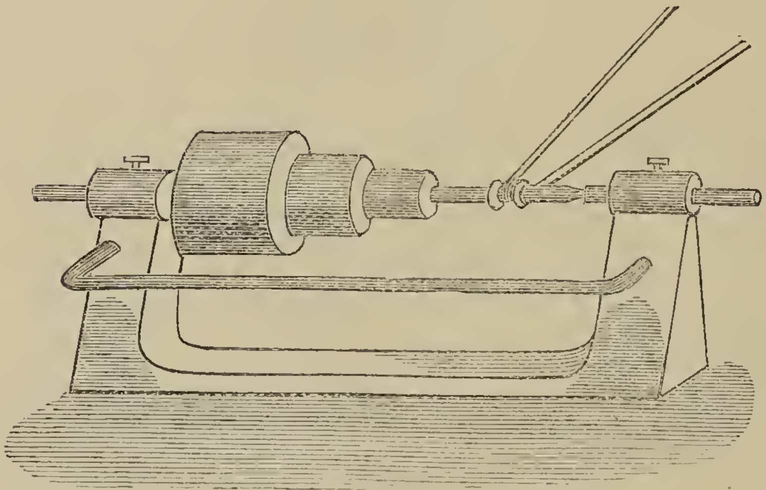
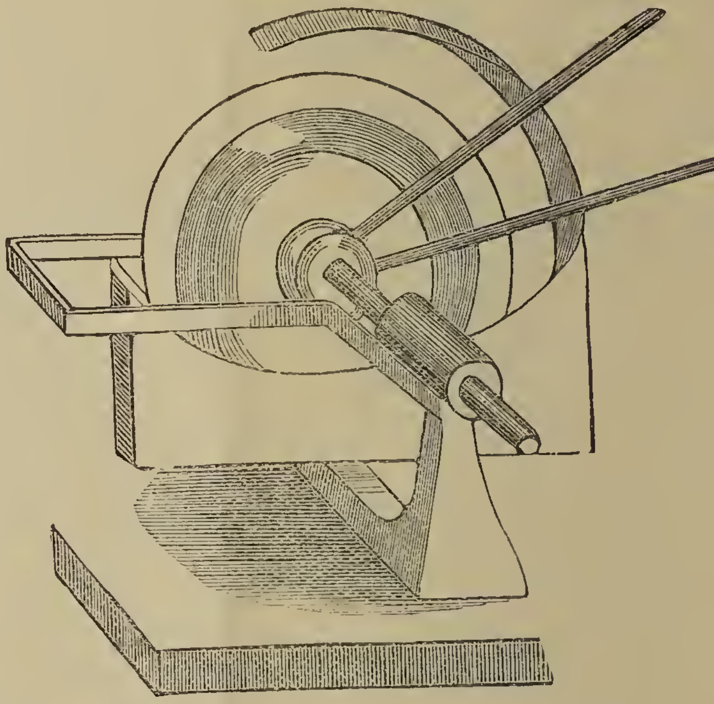


FIG. 4.



At about this time, 1880, a friend sent him a piece of iron ore from East Tennessee, with the request that he would melt it down for him. He did so, but noticed that it melted exceedingly readily and became much more fluid than did other specimens treated in like manner. The question arose in his mind—what was the cause of this? Might not this cause, if detected, aid him in the solution of the iridium question? And it did. He found that the ore in question differed from the other specimens only in the excessive amount of phosphorus present. Very bad for the iron, but, as it proved, good for iridium. Would this phosphorus prove to be his long-sought friend? He resolved to try it, and putting a small amount of iridosmine into a small Hessian crucible, he heated it to a white heat, and then threw in a piece of stick phosphorus. When the fumes had cleared away he poured the crucible, and beheld to his joy and amazement a white, compact, hard metal. No file could touch it, nor acids attack it.

This, the first successful fusion of iridium, made a cast weighing about half-an-ounce. The metal, which we will call "phospho iridium," possessed all the properties of the original iridosmine, except that it was slightly harder—being a good 9 in the scale, and became very liquid at a white heat. It was a phosphide; the problem of the pen points was solved, and many other applications rendered possible; but how to remove the phosphorus and render it again infusible to fit it for applications where intense heats were employed was the question that now arose. At this stage of the process, Prof. W. D. Dudley was called in, and we can do no better than quote a portion of a paper* read by him before the Cincinnati Meeting of the American Institute of Mining Engineers.

At this stage of the discovery we became acquainted with it, and began experiments with the intention of putting the product to some practical use in the arts. It was found that the presence of phosphorus rendered the metal quite readily fusible at a white heat, but this, of course, was an obstacle in the way of its use for electrical purpose. Desiring, therefore, to remove the phosphorus, we found by experimenting that by heating the metal in a bed of lime the phosphorus could be completely removed. In this operation, the metal is first heated in an ordinary furnace at a white heat, and finally, after no more phosphorus makes its appearance, it is removed and placed in an electric furnace with a lime crucible, and there heated until the last traces of phosphorus are removed; and the metal which then remains will resist as much heat without fusion as the native metal.

In mechanical applications, where the metal is not subject to great heat, it is melted with phosphorus and cast into the shape desired, and then ground or worked as the application may require. The first application to which it was put was for the manufacture of the McKinnon penpoints. For this purpose, the metal, after being fused, is removed from the furnace and poured between two slabs of iron, which are kept apart the desired distance so as to make a sheet of iridium of the thickness required. The metal is poured, as I have said, between these plates, and the plates are brought suddenly together, on the plan of a closed ingot with a hinge, so that as the metal cools it is subjected to pressure which closes the pores and makes a very compact casting. The slabs for the McKinnon penpoints are about one-thirty-second of an inch in thickness, and are broken up into small irregular pieces which are soldered on a strip of brass and ground down to a flat surface by means of a copper-lap. The copper-lap (Fig. 1) consists of a plate of copper, about one-half inch in thickness and eight inches in diameter, fixed on a spindle which

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* *Trans. Am. Inst. Mining Engineers*, 1883-4.

is made to revolve from eight hundred to a thousand revolutions per minute; the copper of which the lap is composed is wrought copper, well annealed, and consequently very soft. In order to grind with it, corundum or diamond-dust is mixed with oil and applied to the flat surface of the lap by means of a flat steel instrument, upon which pressure is applied in order to force the corundum or diamond-dust into the copper, thereby making a cutting surface. The iridium to be ground is held against this sharp surface of the lap, and the corundum or diamond-dust gradually cuts the metal away. As the cutting material wears from the copper-lap, another application of the corundum or diamond-dust is made by means of the steel instrument as described; this operation is continued until the grinding is complete. After the slabs are ground to a surface they are then drilled. In the drilling operation, the iridium is first countersunk by means of a diamond drill, consisting of an upright spindle suitably fixed in a frame so as to revolve freely; the bottom of the spindle holds a small rod of brass, to the lower end of which is set a white diamond-splint. The drill is made] to revolve about nine hundred revolutions per minute. The iridium is held up against the diamond with a light pressure, and the diamond gradually makes a conical hole or countersink. After countersinking the iridium, it is finally pierced by means of a copper drill (Fig. 2), which consists of a piece of soft copper wire, which is filed down to a point and set in a drill similar to that in which the diamond is placed, but this drill makes about thirty-five hundred revolutions per minute. Corundum or diamond-dust and oil is put into the countersink opening in the iridium, and then it is held up against the piece of revolving copper. The diamond-dust or corundum, imbedding itself in the copper, acts as a cutting surface, and finally accomplishes the drilling of the hole. The holes having been drilled in the pieces of iridium which were soldered to the brass, the brass is finally dissolved from the iridium by means of nitric acid; and then we have irregular-shaped pieces of iridium, pierced with holes. These pieces of iridium are then soldered in proper position to the end of the McKinnon pen, fitting into the opening of which there is a valve consisting of an iridium-pointed wire. The iridium is then ground to the proper shape on the outside by means of a copper lap, as shown in Fig. 3, consisting of three or more copper cylinders on a common spindle, making about three thousand revolutions per minute.

The operation of sawing iridium is carried on by means of a copper disk (Fig. 4), from four to eight inches in diameter, made of soft thin sheet-copper, held between two clamps, placed on a spindle revolving at the rate of about twenty-five hundred revolutions per minute. This sheet of copper revolves in a box which contains corundum or diamond-dust and cotton-seed oil. The cotton-seed oil with the cutting material adheres to the periphery of the saw, and as the saw comes in contact with a piece of iridium it gradually does the work. Cotton-seed oil is preferred for this purpose to any other oil, on account of its viscosity."

(To be continued).

JAPANESE MATERIALS FOR ULTRAMARINE AND PRUSSIAN BLUE.

By K. IWABUCHI.

For the preparation of ultramarine, the Japanese materials which he took for experiments were *Goto-kaolin*, *Gairome*, *Harima-kaolin*, *Yamato-kaolin*, *Tono-ishi*, from Amakusa, *Tonoguchi*, *Shigaraki-tsuchi*, and *Shiraye-tsuchi*; the analyses of them are given in the table (see next column).

N.B. In all the experiments the mixtures are made according to Gentile's mixture.

	Goto Kaolin (A).	Goto Kaolin (B).	Gairome.	Harima Kaolin.
SiO_2	48·85	48·42	53·90	65·49
Al_2O_3	36·89	37·09	41·95	28·31
Fe_2O_3	0·46	0·50	1·25	0·41
CaO	0·40	0·45	0·56	0·74
MgO	0·15	0·01	—	—
K_2O	6·80	6·43	1·78	0·34
Na_2O	0·87	0·83	0·48	1·44
Loss on ignition ..	5·90	6·16	—	3·16
	100·34	99·89	99·92	99·88
Ratio of Al_2O_3 to SiO_2..	1 : 2·25	1 : 2·22	1 : 2·2	1 : 3·9

	Yamato Kaolin.	Tono-ishi.	Tonoguchi.	Shigaraki.
SiO_2	62·41	74·53	76·78	58·42
Al_2O_3	24·73	16·75	17·02	28·37
Fe_2O_3	2·68	0·75	0·43	1·20
CaO	0·49	1·65	0·41	1·42
MgO	—	0·17	0·11	—
K_2O	0·54	1.88	—	2·53
Na_2O	—	1·58	0·36	2·65
Loss on ignition ..	9·84	3·06	5·22	5·29
	100·69	100·36	100·33	99·88
Ratio of Al_2O_3 to SiO_2..	1 : 4·29	1 : 7·12	1 : 7·67	1 : 3·55

	Shiraye-tsuchi.
SiO_2	47·74
Al_2O_3	36·68
Fe_2O_3	0·42
CaO	0·99
MgO	0·11
K_2O	0·24
Na_2O	0·21
Loss on ignition ..	13·64
	100·03

The ratio of Al_2O_3 to SiO_2 is 1 : 2·21

1. *Goto-kaolin* (*A and B*).—This kaolin occurs as fine powder in the island of Goto, on the southern coast of Nagasaki. Both qualities, A and B, in the carbonate mixture, yielded a light green mass, shrinking regularly on calcination. This mass, after blueing, was found to be rather dull in colour; this is perhaps due to a great amount of K_2O present in them.

2. *Gairome* is a greyish white powder which is used in the village of Seto for porcelain making. Although the green colour was produced on calcination, yet the mass shrunk irregularly. The blue produced was not good, perhaps due to too much Fe_2O_3 and K_2O, the ratio in both cases being 1 : 2·2.

3. *Harima Kaolin* is a greyish stone occurring in the province of Harima. The stone, when powdered, is of white colour. The experiments were tried several times, but all were unsuccessful and finally abandoned. In the experiments with this stone it is mysterious, he says, that SiO_2 being in a great excess, the mixture fused easily; and moreover, the ratio of Al_2O_3 to SiO_2 being more than 1 : 3, the blue colour was not developed, although impurities were found to be very little.

The phenomena similar to those which had occurred during the experiments with Harima kaolin were observed in Tonoguchi, Tonoishi, and Yamato kaolin, in all of which the ratio of alumina to silica exceeds 1 : 3, as seen in its analysis.

4. *Yamato Kaolin* is found in the province of Yamato. It is a greyish white powder, which, on calcination, becomes reddish grey. The carbonate mixture, after calcination, is contracted into a hard, semi-fused mass, yielding no blue colour.

5. *Tono-ishi* is abundantly found in Amakusa, and largely used in Kioto for porcelain making. The deportment of fire was similar to the kaolin from Harima or Yamato, and the result is unsuccessful.

6. *Tonoguchi* is a pure white powder, which, on calcination, remains the same. It is used for making body of porcelain, in the province of Aidzu.

7. *Shigaraki-tsuchi* is largely used at Kioto for making porcelain. The carbonate mixture, after calcination, was already blue. This, after blueing, gave ultramarine of light reddish shade, and it resisted the action of acetic acid and solution of alum.

8. *Shiraye-tsuchi.*—The carbonate mixture, after calcination with proper heat, gave a green mass, which, after blueing, gave ultramarine of little darker shade, but very fine, having some lustre. Out of 136 grains of carbonate mixture, that is 50 grains kaolin, 50 grains Na_2CO_3, 30 grains S, and 6 grains carbon, 53 grains of green ultramarine were obtained, and for blueing, double quantity of sulphur is required; finally, the ultramarine obtained weighed 42 grains, therefore the produce was about one-third of the original mixture.

Sulphate of Ultramarine.—Ultramarine made with the carbonate mixture is dark in colour, and being desirous to obtain ultramarine of light shade, the following sulphate mixture was taken:—

Kaolin	100 parts
Na_2SO_4	90 ,,
Charcoal	17 ,,

The mixture, after calcination at red heat during four hours, was completely converted into a green mass, but this, after blueing, did not give a nice colour. This was, perhaps, due to the deficiency of Na_2SO_4, so the experiment was tried again, using the same quantity of kaolin and Na_2SO_4. The mixture on calcination fritted slightly, but was completely transformed into a green mass. The blue obtained is not so dark as the carbonate ultramarine, but is inferior in its quality deprived of any lustre.

Carbonate of Ultramarine with Shiraye to which Silica is added.—In order to make the ratio of Al_2O_3 and SiO_2 as 1 : 3, he introduced free silica and tried the experiment. In order to make the ratio of Al_2O_3 to SiO_2 1 : 3 calculation was made as follows:—

Since the kaolin was used after calcination, the percentage composition of the calcined kaolin was worked out from the preceding analysis, and it becomes as follows:—

		Equiv.
SiO_2	55·26	0·921
Al_2O_3	42·45	0·416
Fe_2O_3	0·48	
CaO	1·14	
MgO	0·13	
K_2O	0·25	
Na_2O	0·22	

Now, $3 \times 0{\cdot}416 = 1{\cdot}248$, an amount of SiO_2 in equivalent necessary for the required ratio, but 0·921 is present in kaolin; therefore $1{\cdot}248 - 0{\cdot}921 = 0{\cdot}327$ equivalents of SiO_2 are necessary, which in weight are equal to $0{\cdot}327 \times 60 = 19{\cdot}62$. Hence, to every 100 grs. of the calcined kaolin 19·62 grs. of free silica must be added.

Now, by adding 19·62 of free silica the carbonate ultramarine was made, heat of calcination being far lower than in the case when SiO_2 was not added, because by heating the mixture in exactly the same way as the carbonate mixture without addition of SiO_2, three-quarters of the mixture were converted into a brownish mass. The result was tolerably good with low heat of calcination.

Sulphate of Ultramarine with an Addition of SiO_2.—The following successive sulphate mixtures were tried with the kaolin, to which SiO_2 had been added, so as to make the ratio of Al_2O_3 to SiO_2 1 : 3:—

Kaolin	100	100	100
Na_2SO_4	83	90	100
C	17	17	17

With all these mixtures the experiments failed completely. Then the kaolin was first strongly ignited, whereby it fritted to three-fifths, and was experimented for the sulphate mixture; negative result was again obtained. From these it is probable that sulphate ultramarine cannot be formed in the case of an addition of free silica to make $Al_2O_3 : 3SiO_2$. The writer tried the experiment by mixing shiraye with another kaolin rich in SiO_2, so as to make the ratio of Al_2O_3 to SiO_2 1 : 3 in the mixed kaolin. For this purpose tonoguchi was added. The calculation was made as follows:—

Equivalents of Al_2O_3 and SiO_2 in the calcined shiraye are 0·416 and 0·921 respectively, and those in tonoguchi 0·179 and 1·345.

	Shiraye.	Tonoguchi.
Al_2O_3	0·416	0·179
SiO_2	0·921	1·345

To every 100 parts of shiraye x parts of tonoguchi are to be added, the quantity of which is found by the following equation:—

$$0{\cdot}921 + \frac{x}{100} 1{\cdot}345 = 3\ (416 + \frac{x}{100} 0{\cdot}179)$$

$$x = 40{\cdot}45.$$

Hence to every 100 grains of shiraye 40·45 grains of tonoguchi ought to be added in order to make up the ratio of Al_2O_3 to SiO_2 1 : 3.

Now, shiraye and tonoguchi were mixed in the above proportion as intimately as possible, and the powder was tried in the carbonate mixture; the result was positive, giving ultramarine of reddish shade.

The same thing was tried in the sulphate mixture yielded no ultramarine. The experiment shows that the sulphate ultramarine cannot be formed also in the case of an addition of another clay so as to make the ratio of Al_2O_3 to SiO_2 1 : 3.

Mixed Ultramarine.—Carbonate ultramarine made with shiraye was too deep in colour, and sulphate ultramarine made with it was too light. With the view of harmonising the two colours, he tried an experiment, using the following mixed proportions:—

Kaolin	100 parts
Na_2SO_4	41 ,,
Na_2CO_3	41 ,,
C	17 ,,
S	13 ,,

The green mass formed on calcination was homogeneous, and gave, after blueing, tolerably good ultramarine, though not so lustrous as carbonate ultramarine. The quantity formed was about one-fourth of the original mixture. For the object of improving the colour, he tried another experiment, using the following mixture:—

Kaolin	100 parts
Na_2CO_3	60 ,,
Na_2SO_4	40 ,,
S	50 ,,
C	22 ,,

The colour produced was deeper but not much improved.

Carbonate ultramarine was then made with different proportions:—

Kaolin	100 parts
Na_2CO_3	90 ,,
S	100 ,,
Resin	6 ,,
C	6 ,,

Although the result was positive, the ultramarine produced was no better than carbonate ultramarine. This was perhaps due to irregularity of heat in calcination.

After all, carbonate ultramarine made with Gentile's mixture was found to be the best, although it is deep blue in shade. As to the question whether the ultramarine would be profitably manufactured in this country, he considered it hopeless, as the present price of soda and sulphur is too high compared with that in other countries. Leaving out an interest for capital, expenses for manipulation, &c., the cost of the materials for the formation of ultramarine will be only little in excess over the total amount of selling price.

The price of shiraye from the province Mino costs 1·5 yen per 16 grms. Supposing one-tenth is to be lost by elutriation, 16—1·6 = 14·4 grm. costs 1·5 yen.

Now, Gentile's mixture being used:—

Kaolin	100 parts
Na_2CO_3	100 ,,
S	60 ,,
C	12 ,,

The following quantities of Na_2CO_3, S, and C are required for 14·4 grms. of shiraye:—

Na_2CO_3	14·4 grms. (120 lbs.)	costs 12 yen.
S	8·64 grms. (71 lbs.)	costs 29 ,,
C	1·73 ,,	—
These, together with the price of 14·4 grms. of shiraye		1·5 ,,
Cost of production ..		42·5 yen.

Referring to "Watts's Dictionary of Chemistry," we see that out of 30—32 cwts. of the mixture, 15 cwts of the blue ore are obtained in 14 days. Assuming that we can get ultramarine at this rate, 16·8 grms. of blue ultramarine can be obtained out of 39·17 grms., and 39·17 grms. are equal to 140 kins = 135 lbs., which corresponds about to a day's production, viz., $\frac{15}{14} = 1\frac{1}{14}$ cwt. = 120 lbs.

Now, the price of best ultramarine in Tokio is 30 cents per kin On the assumption that we can sell ultramarine made with shiraye at the same price, the total amount of selling price will be 140 × 30 = 42 yens. Notwithstanding there are many points which have been disregarded, and, moreover, the assumptions here made are extremely favourable to the utmost production of ultramarine and to tha higher price of it, yet the cost of production and the total amount of selling price are found to be nearly equal, so that, at the present condition, the profitable production of ultramarine in Japan cannot be expected.

A limited number of collections at hand obliges the writer tos top the experiments. But so far his experiments show that, in the favour of Furstman, only two aluminium silicates are fit for production of ultramarine, viz., $Al_2O_3 \cdot 3SiO_2$, and $4Al_2O_39SiO_2$, but from the experiments made by Knipp and Ebell, who took 45 parts of SiO_2 and 37 parts of Al_2O_3 (ratio being 1 : 2), it appears that a good ultramarine may be produced, though the ratio of Al_2O_3 to SiO_2 is 1 : 2. This has also been proved to be true by the experiments made by the author himself.

ABSOLUTE ALCOHOL.*

It appears to be very certain that no alcohol has as yet been rendered entirely anhydrous, and therefore the term absolute as applied to any yet made is not strictly correct. For all practical purposes, however, it is a very convenient term by which to designate a rather indefinite substance, but one now applied to a great many important uses, and therefore itself growing in importance.

It is not difficult to get alcohol practically free from all impurities, including water as one, but to free it from the last one-thousandth part of water is very difficult indeed—so difficult, that traces of this ultimate fraction of water have so far always been retained. Hence, in considering it as absolute alcohol it can only be regarded as being freer from all other impurities than from water, and as being more or less free from water. No alcohol should be called absolute, however, that contains less than 99·4 p.c. by the best determinations. When carefully freed from all impurities except water, specific gravity becomes a very accurate indication of strength, and it has always been relied upon as the decisive test. For many years each careful observer reduced the specific gravity little by little to those upon which the tables of the present day are based, by using new appliances which the progress of knowledge supplied to his hands, and the object of this note is to show that improvement in these appliances is not yet at an end.

Some writer has well said, in substance, that in the advancement of knowledge the position of each day should be occupied as the nomadic Arabs occupy their tents, ready at any moment to pick up and move on.

In the manufacture of absolute alcohol in considerable quantities by the very slow, cold percolations through large and successive portions of quicklime, the writer has not unfrequently seen it come from the rectifying still of a specific gravity below that of the lowest of the tables and of the best and most recent authorities; and the entire product of the process for the past two or three years has been of such strength that all the hydrometers tried have sunk below the reading scale. In one instance, a Government Inspector pronounced the alcohol to be 102 p.c. strong! Another inspector made it 99·8 p.c., but he could not possibly have done this with his official instruments, because his hydrometer would sink below the reading scale, even when the alcohol had been exposed to the air by several trials. These observations were made upon alcohol that, having been managed with a considerable air contact, could not be completely anhydrous, since very strong alcohol takes moisture from the air very rapidly indeed, and changes proportionately in specific gravity. It was therefore concluded that the tables were all too high for the present time, and that the subject merited a re-investigation. This was undertaken, and has been carried out with much care and pains, with the results now to be offered.

Preliminary to the investigation the authorities on the subject were carefully examined. They were found to be very numerous, very discordant, and in an almost hopeless state of confusion. Much of the discord and confusion arises from the use of different standards of volume in taking the specific gravities, from failure to state what standard was used, and from making the observations at many different temperatures.

In "The Constants of Nature," compiled by Frank Wigglesworth Clarke, S.B., and published by the Smithsonian Institution, no less than thirty-three specific gravities from twenty authorities are given, with the statement that the compiler considered it best to give only the more important determinations. Hardly any two of these are in fair accord, the same authority often giving several different determinations.

Three standards of volume, at least, appear to be in common use, and as they are rarely stated they have to be either deduced or inferred.

The general statement of good authorities—Watts's "Chemical Dictionary," for example—is, that in Great Britain the standard volume for unity is a volume of pure water at 60° F. = 15·6° C., while in France and Continental Europe generally the volume of water at 4° C. = 39·2° F. is taken for the unity standard.

It is probable from some of the figures given that some of the authorities give true specific gravities—that is, where equal volumes of the standard water and the alcohol are weighed at the same temperature and corrections applied for difference in density between the substance and the weights used. But it is equally probable that most of them give apparent specific gravities; that is, where the standard is at one temperature, and the equal volume of the alcohol is weighed at another temperature, without corrections either for expansion of the vessel used, or for density of weights or barometric pressure.

These apparent specific gravities are far the most useful, and therefore most important, and if a common standard was adopted they would be all sufficient, because easily

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* From An "Ephemeris of Materia Medica, Pharmacy, Therapeutics, and Collateral Information," by E. R. Squibb, E. H. Squibb, and C. F. Squibb.

and quickly taken, and easily compared with sufficient accuracy.

In true specific gravities—that is, where the standard and the liquid of the same volume are weighed at the same temperature—the chief correction to be applied is for difference in density between the liquid and the weights. This error is in the fifth decimal place, and is only important when a very high degree of scientific accuracy is aimed at. The error is plus and has to be subtracted, the observed weight being that much greater than it would be in a vacuum. It, therefore, makes the observed sp. gr. too high.

In apparent specific gravities—that is, where the liquid is weighed at other temperatures than that of the standard, another error comes in, and that a much greater one—namely, the expansion of the vessel in which the weighing is done. A glass vessel holding 1000 grms. of water at its maximum density, or 4° C., will so expand at any higher temperature as to hold 0·025 grm. more of water for each 1° C. This is also a plus error, making the observed weighing greater than it should be, but as it requires 20° C. to make it reach the third decimal place in the sp. gr. of alcohols, it is not of great practical importance in every day uses.

In specific gravity tables for daily use in the arts, neither of these corrections should be applied, because it is neither convenient nor easy to apply them in common practice to the liquids which are to be compared with the tables. Any one can take apparent specific gravities quickly, and with a fair degree of accuracy, and in referring these to tables there should be an accord between the observations and the tables. Besides, when these corrections are disregarded the errors are still within the sphere of error of the tables in common use. The closest attainable specific gravity for absolute alcohol being reached, and being stated both in apparent and true terms to the fifth decimal place, is all that is needed to correct the tables at any desired point, leaving the more general correction to be made as better usage may demand it.

The very numerous any very discordant authorities on the strength of absolute alcohol have been frequently noticed and criticised of late years, and nowhere better than by the eminent Russian authority Mendelejeff, and the accuracy, care, and labour of this author have given the example which the writer has tried to imitate in the following investigations.

D. Mendelejeff published in St. Petersburg, in 1865, a quarto volume of 119 pages, exclusively on the subject of absolute alcohol, A copious abstract of this paper was published in the *Zeitschrift für Chimie*,—Beilstein and Fittig, 1865, under the heading "Ueber die Verbindung des Weingeistes mit Wasser." From this abstract the writer's assistant, Miss Marie O. Glover, S.B., made notes and translations, of which great use has been made in this paper. Mendelejeff is not only the latest, but by far the best authority which has been found on the subject. He reached a true, corrected sp. gr. of 0·79367 at 15° C., compared with water at 4° C., which is practically in accord with Fownes and Drinkwater, and nothing could be usefully added to his admirable researches, except that the improved mechanical appliances of the twenty years since he wrote have probably brought it within the reach of any one going over the subject at the present day to obtain an alcohol that is more nearly anhydrous.

The very thorough investigations of Gilpin for the British Government from 1788 to 1794, and published complete in the *Philosophical Transactions* of the latter year, brought the strength of alcohol to a sp. gr. about 0·7939 at 15·6° C.=60° F. compared with water at 4°.

Fownes's *Philosophical Transactions*, 1847, and Drinkwater,[*] each went over the subject some fifty years later, and brought the sp. gr. down to 0·7938 and 0·79381 at 15·6 C.=60° F. compared with water at the same temperature.

Kopp, in his elaborate researches on the expansion of liquids by heat, in 1855 and 1856, embraced alcohol among the liquids, and he is often quoted as authority for the sp. gr. of absolute alcohol. But the best results given by him are considerably above those of earlier and later observers, and it is doubtful whether he supposed that he obtained anhydrous alcohol, or sought for it especially, since it was not demanded by the line of his special research.

Next came Mendelejeff with the paper previously referred to, and these were the chief among the many original observers. In regard to the work of Gay-Lussac and Tralles, Mendelejeff remarks, in substance, that their numerous grave errors place them outside the pale of rational criticism. And to these the commonly accepted German authority, Stampfer, may well be added.

It is particularly unfortunate that these three authorities should, by the construction of their elaborate tables upon erroneous bases, have misled the world for so many years upon this enormous alcohol interest.

Tralles, in 1811—Gilbert's *Annalen*, xxxviii., 386[*]—adopting Gilpin's researches as far as they went, deduced a sp. gr. for anhydrous alcohol of 0·7939 at 15° C.=59° F. compared with water at 4°. This was nearly correct from his data. But he does not use this, and does use instead, as the basis of all his work, an erroneous equivalent to it. He states that this sp. gr. is equivalent to 0·7946 at 15·6° C.=60° F. compared with water at 15·6° C.=60° F., and upon this statement all his tables, excepting one, are based. The one exception—namely, that based on a temperature of 15° C.=59° F. compared with water at 4° C., is not used except as a basis for his erroneous deduction. Instead of 0·7946 at 15·6° C. compared with water at 15·6° C. being the equivalent to 0·7939 at 15° C. compared with water at 4° C. the difference is only about 0·00021, making the sp. gr. he should have deduced from his data about 0·79411.

Gay-Lussac, in 1824, practically reaches the same error with Tralles, which he appears to adopt from Rudberg, by giving 0·7947 as the sp. gr. of anhydrous alcohol at 15° C.=59° F. compared with water at 15° C.=59° F., supposing this to be the maximum density of water,[†] although it was well known in his day, and long before it, that the maximum density of water was 4° C.=39·2° F. All his voluminous tables are pervaded by these errors.

Stampfer, who appears to be a commonly accepted German authority, whose table is given in Hager's "Untersuchungen," and in this country in Hofmann and Power's "Examination of Medicinal Chemicals," at p. 207, gives the sp. gr. of absolute alcohol at 0·7951 at 15° C.=59° F., compared with water at the same temperature. This, of course, is still more inaccurate than either Tralles or Gay-Lussac.

Tralles's tables are accepted and established by law in both Great Britain and this country, and although the error amounts to just about a quarter of one per cent between Fownes, Drinkwater, and Mendelejeff, who are practically in accord, and Tralles and Gay-Lussac, who are also practically in accord, this difference is accountable for the loss of millions of revenue. The British Government adopted the tables, and re-adopted them before the extent of the errors was fully recognised, and have simply adhered to them rather than suffer the inconvenience of changing them. But in this country they were adopted long after the better determinations were published, and, since it is now to be hoped that the tax on spirit here will soon be abandoned, it would be unwise to change.

In the writer's investigations he accepted the statements of Mendelejeff and others, that caustic lime was the best agent to use for dehydration, and that this agent leaves the alcohol quite unchanged in elementary composition. The improvements he has been able to make

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[*] *Memoirs of The Chemical Society*, 1848, vol. 3, p. 447.

[*] Quoted from Watts's "Dictionary of Chemistry," p. 83;

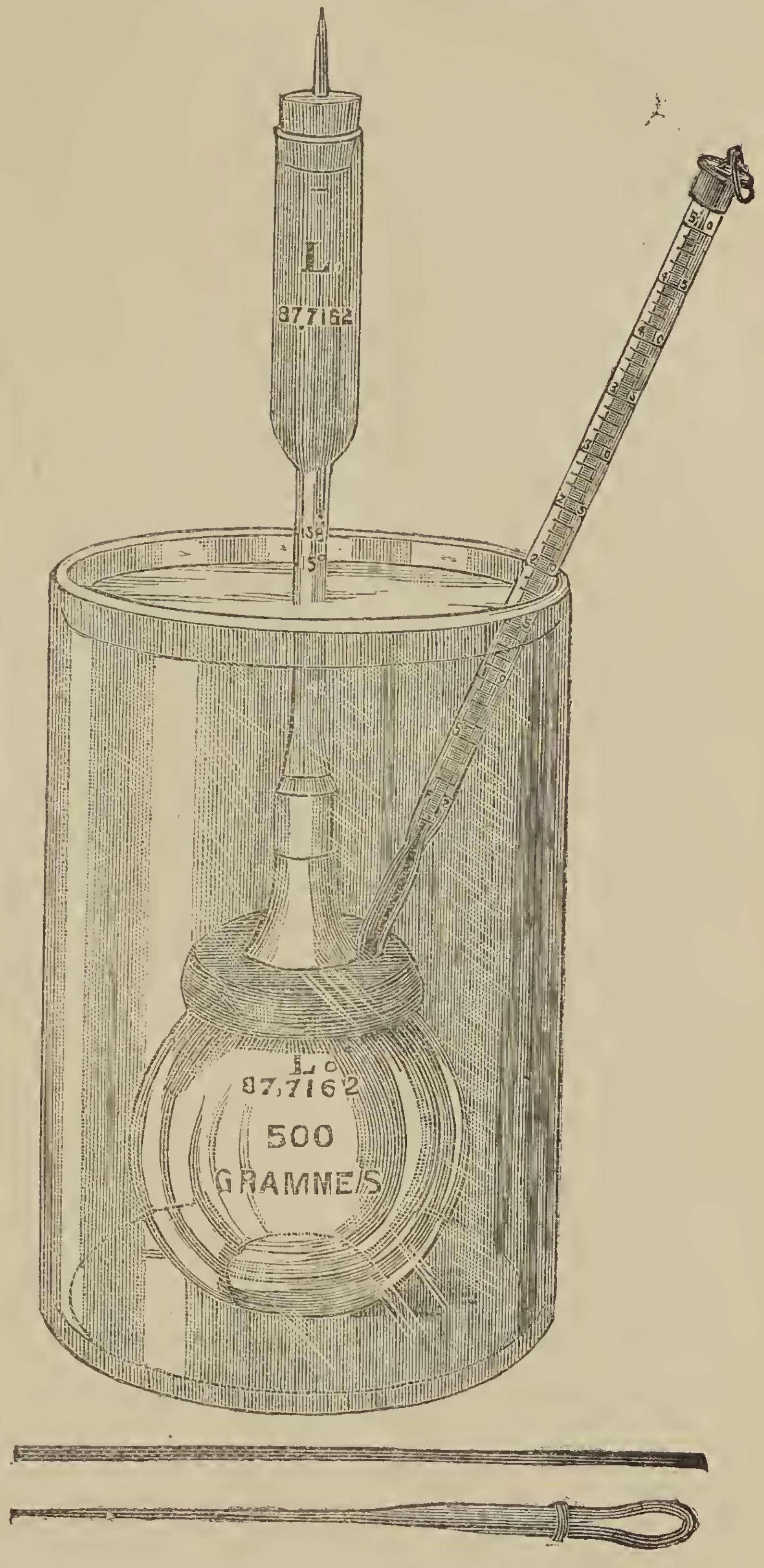
[†] Quoted from "Muspratt's Chemistry," p. 123.

upon the methods of previous investigations have been chiefly—First, in starting with alcohol of much lower sp. gr. than any before used, and in having this in great abundance for the desired modifications and repetitions of the process. Second, in having a mechanical shaker, driven by steam power, wherein two bottles of the capacity of four litres, or one gallon each, could be shaken at the rate of 240 vibrations a minute for any desired length of time, thus getting a better agitation and a more effective contact with the lime than has been previously practicable. Third, in filtering out all suspended lime before distillation, in an apparatus well supplied with desiccated air. Fourth, in distilling in a partial vacuum equal to 23 inches of mercury, thus reducing the boiling point to about 51° C. = 124° F., and freeing the distillate from dissolved air and other vapours, and from any traces of ethers or liquids of low boiling-points. Fifth, by distilling under this partial vacuum directly into the sp. gr. flasks. Sixth, by the use of special sp. gr. flasks of very large size, so as to reduce all errors of filling and weighing.

The thermometers used were graduated to 0·02° C., and were read to less than 0·1°, and were corrected by comparison with a standard instrument just before the observations were commenced, and as the investigation continued over nearly three months, they were twice re-compared during that time.

The balance used for the final determinations was examined and put in good order by Becker and Sons, for the weighings, and was sensitive to five milligrammes when loaded to 500 grms. with the flask and contents; and the weights were a new and accurate set obtained for the purpose.

The rougher determinations were made in a sp. gr. flask of 500 grms. capacity; but the finer determinations were made with two special flasks of better construction. One of these, chiefly used as a check upon the other, is of 100 grms. capacity, and was used on a fine balance, sensitive to 0·0001 grm. when loaded, and with a different and very fine set of weights. The other flask has a capacity of 500 grms., and is illustrated in the accompanying woodcut. In construction, it is simply an enormous thermometer of short range. The flask has a very carefully and accurately ground stopper of barometer tube, the tubular portion being about 8 centimetres or 3·2 inches long, and about 3 millimetres, or one-eighth inch bore. The upper prolongation of this is a very much larger tube of about the same length, and of nearly 2 centimetres or three-quarter inch internal diameter, to receive the expanding liquid as the apparatus is warmed up to the temperature of the balance case before the weighings. The ground joint is lubricated and made entirely tight by a very small portion of pure soft paraffin, which does not alter the tare perceptibly. The calculations of sp. gr. are very much simplified, and liabilities to errors reduced by having the capacity marks adjusted to 500 grms. There are three graduations on the tube, all for 500 grms., of recently distilled and recently boiled pure water. Filled to the lower mark, the flask holds 500 grms. of the water at its maximum density of 4° C. = 39·2° F. To the second mark it holds the same quantity, but at 15° C. = 59° F., and to the upper mark the same weight, but at 15·6° C. = 60° F. These adjustments were all made in a bath continuously and vigorously stirred, and kept at the exact temperature by continuous additions of cold or warm water until the column in the tube ceased to rise or fall. In practice it was found that when the bath and the column had remained constant for about ten minutes, no change occurred by prolonging the time. A change of 0·1° C. in the temperature of the bath was hardly perceptible when the flask was charged with water to the lower, or 4° mark, because water changes very little in volume when within a degree of its maximum density, but at both the upper marks a tenth of a degree change in the bath was easily seen, and reached its maximum in about ten minutes. When charged with alcohol, however, a tenth of a degree in the temperature of the bath gave a difference of more than a centimetre or three-eighths of an inch in the height of the column, and the whole column was not long enough for a single degree. Thus changes in the alcohol could be easily read to the one-hundredth of a degree of temperature of the bath, and thus the errors of filling, and of form and size of meniscus are reduced far within the error of any balance in the weighings. This adjustment by corrected thermometer in the bath, and active stirring of the water, was not only used in adjusting the capacity marks with the standard distilled water, but also with the adjustment of the alcohol for each observation, and so well did it answer, that great confidence is felt in the results attained by it. A collar of lead is shown which keeps the flask from floating in the bath.



It is very convenient to have that part of the tube in which the adjustments are made graduated in millimetres, so as to see better when the liquid ceases to rise or fall before the final adjustment to the mark.

For the adjustment of the alcohol to the marks—which, of course, is done while the flask is in the bath—a long and very fine pipette with a rubber tip is shown. Properly constructed and skilfully managed, this, after a little practice, will be sufficient to make the adjustment to the marks with great accuracy, but if a very little liquid is to be taken out, a narrow strip of bibulous paper is better. For working as rapidly as is practicable two baths are needed: one at the capacity temperature for adjustment of volume, and the other at the temperature of the balance case to warm or cool the flask before weighing.

As a counterbalance or tare for the sp. gr. flask, the very clever device of Mr. Drinkwater was used, but was improved by sealing up the counterpoising flask at the time of adjustment. A flask of the same glass and the same capacity was so constructed that the closed stopper could be sealed in when made to accurately counterpoise the sp. gr. flask on a fine balance, the counterpoising being done to within half a milligramme. The stopper furnished at top with a ring and a hook of platinum wire, was then sealed in at the time of adjustment, so that the contained air can never change either in volume or humidity, or weight, with any barometric or other changes. This is hung from the hook over the balance pan and leaves the pan clear for weights. By the use of such a counterpoise the error for buoyancy of air, or difference in density between the brass weights and the sp. gr. flask and contents is very much reduced, so that being removed to the fifth decimal place, and the weighing being only to the fifth, the correction may be disregarded and omitted.

With such an arrangement and a little practice, six or seven very good determinations may be made in a day, at any of the three common standard temperatures to which the flask is adapted.

The common standard for alcohol in this country, obtained from the common usage in Great Britain, is to weigh it at 15·6° C. = 60° F., compared with water at this same temperature as the standard volume for unity or 1·0000, and this is convenient, not only because the usage is so well established, but also because it is a true specific gravity, in that it is at once fairly accurate without correction for expansion of glass, as when the standard volume for unity is at a different temperature from the weighing. Nevertheless, water at 4° C. is a much better unity standard, and is rapidly becoming the universal one.

To economise time and space in what is to follow, whenever a sp. gr. is given without giving the temperature or standard, it is to be understood as taken at 15·6° C. = 60° F. compared with water at the same temperature, as unity. It is rather a curious coincidence which could hardly have escaped the notice of Tralles, had he taken his specific gravities himself, that the apparent sp. gr. of an alcohol of 0·79390 at 15° C. = 59° F., compared with water at 4° C. = 39·2° F. is only about 0·00002 less than the sp. gr. of the same alcohol weighed at 15·6° C. = 60° F., compared with water at 15·6° C. = 60 F. as unity, this latter being 0·79392.

The alcohol for the following determinations was prepared as follows:—

Lumps of good caustic lime were ground to a coarse and fine powder, re-calcined at a bright red heat, and then, cooled in a close vessel, it was kept in bottles ready for the repeated dehydrations. About a half kilogramme or 1·1 pounds of this lime was put into each of two bottles of the capacity of 4 litres or one gallon, and upon it was poured about 2 litres or half a gallon of alcohol of a sp. gr. of 0·7939. These were well corked, put into the shaking machine and shaken at the rate of 240 vibrations per minute until the contents became warm, or for about 15 minutes—then allowed to cool, and then shaken again until the aggregate time in one day amounted to about two hours. This was repeated on the second day and on the third, and after settling over night the milk-like alcohol was drawn directly from the bottles without air contact into the distilling apparatus previously filled with day air, by means of a Sprengel water pump.

The distilling apparatus consisted of a globular wide-necked flask of about 5 litres capacity, in a water-bath with very little water. This flask was furnished with a large rubber stopper with three tubes—one for a charging tube that passed down to the bottom, and was controlled outside by a rubber tube and pinch-cock; another for thermometer, and a third large tube leading the vapour to the condenser. The condenser was a tube of block tin passing through a long wooden trough capable of holding a plentiful supply of broken ice. The end of the condenser was connected by rubber tubing with one tube of a tapering rubber stopper of two tubes—the stopper of a size to fit the sp. gr. flasks. The second tube of this stopper was connected with the water pump by rubber and glass tubing. The flasks having been well rinsed with absolute alcohol, and the large one connected by the ingress tube with a double air-drying apparatus of sulphuric acid and chloride of calcium, a current of dried air was drawn through the whole apparatus by the pump during an hour or two. Then the ingress tube was connected with the alcohol bottles, one after the other, and the milky alcohol from the shaker was drawn in by the pump, free from any but the very fine particles of lime which refused to settle out with the coarser ones. When charged and properly closed, and the mercurial gauge of the pump showing a partial vacuum of 15 to 23 inches, the water of the bath was warmed up until the liquid boiled—explosive boiling being prevented by platinum scraps and pieces of tobacco pipe-stem. An apparent boiling always preceded the true boiling from the very commencement of the warming, and was always quite active, thus freeing the alcohol from air, ethers, &c.; and during this bubbling the condenser was not cooled with ice, so that the pump was allowed to take off all these vapours before the true boiling-point was reached. This true boiling-point varied between 49° and 55° C., according to the vacuum. The first distillate was received in a 100 c.c. flask until this was filled. Then the two rubber tubes connected with the stopper were closed with pinch-cocks, the filled flask taken off, and replaced by one of the sp. gr. flasks. The tube leading to the pump was then opened, and the flask exhausted until the pump gauge had again reached 20 to 23 inches. Then the tube from the condenser to the flask was opened. The boiling and condensation having continued during this changing of receiving flasks, a considerable quantity of condensed liquid flows at once into the newly-placed flask, and then the distillation proceeds until another change is required.

In this way the sp. gr. flasks and others are filled until about 5 or 6 fractions are obtained at each distillation, the process being stopped while there is yet 100 c.c. or so in the distilling flask. This residue is thrown away, and the flask well rinsed out with the absolute alcohol and dried by a current of dried air as before, when it is ready for a new distillation. No lime, nor any other sensible impurity was ever found in any of the distillates, and they all, with the possible exceptions of the first two, consisted only of the alcohol and the traces of water still held. All the distillations were managed in this same way from first to last.

(To be continued.)

Detection of Morphine in the Urine of Opium-Eaters.—MM. Notta and Lugan.—Morphine absorbed is in great part eliminated unchanged in the urine, provided that the action of the kidneys is normal. Its presence may be sometimes directly determined by means of the reagents of Mayer and Bouchardat. But it is necessary first to ascertain that the urine contains neither sugar nor albumen, and also to examine if the precipitate obtained is soluble in alcohol at 90 per cent. If the urine gives no precipitate with the reagents above mentioned, the morphine must be sought for by means of the methods of Lugan, of Otto and Dragendorff, of Uslar and Erdmann,

PROCEEDINGS OF SOCIETIES.

GLASGOW PHILOSOPHICAL SOCIETY.

Chemical Section.

At the first meeting of the Society, held on November 24th last, the following were elected officers of the Chemical Section for the session 1884-5:—

President—J. J. Coleman, F.I.C., F.C.S.

Permanent Vice-Presidents—Professor Fergusson, M.A., F.I.C., F.C.S; J. Mactear, F.I.C., F.C.S.; E. C. C. Stanford, F.C.S.; R. R. Tatlock, F.R.S.E., F.I.C., F.C.S.; W. Wallace, Ph.D., F.R.S.E., F I.C., F.C.S.

Elected Vice-Presidents—W. J. Chrystal, F.C.S.; J. Clark, Ph.D., F.I.C., F.C.S; A. Whitelaw.

Committee—W. J. Chrystal, F.C.S.; J. Clark, Ph.D., F.I.C., F.C.S.; J. B. Hannay, F.R.S.E., F.C.S.; G. G. Henderson, M.A., B.Sc.; C. Hope; J. Mayer, F.C.S.; J. Park; J. Snodgrass, F.C.S.; R. R. Tatlock, F.R.S.E., F.I.C., F.C.S.; R. T. Thomson; A. Whitelaw; T. N. Whitelaw.

Hon. Treasurer—Dr. Wallace City Analyst's Laboratory, 138, Bath Street.

Hon. Secretary—J. Mayer, F.C.S., 2, Clarinda Terrace, Pollokshields.

The Graham Gold Medal, founded in memory of Dr. Graham, is awarded triennially for the best chemical research during the preceding three years. It is open to the world, and is accompanied only by the condition that a paper embodying the results of the research must be read before the Chemical Section of the Glasgow Philosophical Society. Awarded, 1884, to Edward C. C. Stanford, F.C.S., Chairman of the Glasgow and West of Scotland Section of the Society of Chemical Industry. It was presented by Dr. J. B. Russell at the Philosophical meeting on Wednesday. December 17th, in the absence of Mr. Coleman.

Dr. Russell read the following letter from him:—

Glasgow, December 15, 1884.

To the President of the Philosophical Society.

Dear Sir,—As President of the Chemical Section of the Society, I hand you herewith the Graham Medal for 1884, and have to request you to be good enough to present it to Mr. Edward C. C. Stanford, to whom it has been awarded by Professor Crum Brown, of Edinburgh, the adjudicator for 1884. Twenty years ago, or more, Mr. Stanford conducted in a London scientific laboratory experiments upon sea weeds, in which he showed that by retort distillation being employed in the place of open air calcination (as then practised) most valuable chemical products, including iodine and bromine, could be recovered. With great energy Mr. Stanford organised large manufacturing operations in the Western Islands of Scotland, for carrying the process into practical operation; and although other sources of iodine and bromine being discovered in Peru and Chili interfered with the profits of the undertaking, nothing could dim the brilliancy of the researches which inaugurated it. Mr. Stanford, was not, however, daunted, but returned to his old love, and has recently succeeded in extracting from sea weeds, by another process, large quantities of an elastic gummy substance which he calls algin, which promises to be valuable in the arts, and to find profitable employment for the indigent population of the Western and other Islands where sea weeds accumulate in prodigious quantities. It is for this paper that the medal is awarded, but we cannot forget that it is merely the culmination of the work of nearly a quarter of a century by a chemist whose great ability has been long acknowledged by his fellow chemists, and whose patience and persistency is worthy of the highest admiration—Yours faithfully,

(Signed) J. J. Coleman.

Dr. Russell said—Mr. Stanford, I feel happy as a personal friend that it has fallen to my lot to convey to you this medal, which I now do on behalf of the president of the Chemical Section of this society.

Mr. Stanford, in reply, said—It has been said that the highest of all praise is that which comes from one who is worthy of praise himself. He must, therefore, attach a high value to any encomiums from such an eminent technical chemist as Mr. Coleman; but he would deduct a large percentage from his very flattering letter, and also from the equally kind words of Dr. Russell, and place it to the credit of a warm friendship which had for many years subsisted between them. Under ordinary circumstances he would have preferred to receive this splendid tribute of the esteem of his brother chemists in that silence which is often more eloquent than any language; but there were circumstances attending this award which rendered it doubly interesting and doubly valuable to him—circumstances which he begged permission to communicate. They would be aware that the subject of his researches presented a very wide field, one of considerable importance, but a field which was comparatively untrodden, and one of which his brother chemists had left him in almost undisputed possession. It was not, therefore, remarkable that he had been enabled to make some discoveries in it; but it was remarkable, in reference to this award, that his first connection with this subject formed also his first introduction to the late Professor Graham. His first paper was written in competition for the Trevelyan prize, a prize of £100, offered some twenty-four years ago through the Society of Arts by Sir Charles Trevelyan for the best essay on the economic application of seaweed; the jurors awarded that prize to him, but for some reasons which he need not enter into here, and which he never quite understood, it was withdrawn. Professor Graham, the principal juror, insisted that the prize should be handed over to him, and much correspondence with the donor and the Society of Arts ensued. The result was that he never obtained the prize, but he secured what was far more valuable and far more agreeable to him, and that was the life-long friendship of the late Professor Graham. Every chemist throughout the world was familiar with the splendid series of researches which will hand down the name of Graham as one of the most talented scientific men of our age. Thanks to his friend James Young, the people of this city are familiar with his features from his statue in George Square. Thanks to another friend, Dr. Angus Smith, in that little work recently published and so ably edited by Mr. Coleman, all can obtain some glimpses into his private life. But it was only given to those who have known him personally, as he had, to realise the loveable and loving character of the man. He did not know how universal that affection was until he had visited Scotland and Ireland some years ago with introductions from Graham to the principal scientific men of both countries. He was received everywhere with the greatest kindness, and he had always attributed his good position amongst the chemists of his adopted country rather to the introductions of Graham than to any merits of his own. These were the circumstances which rendered this award doubly interesting and doubly valuable to him, and they would readily admit that in confiding this valuable token to him they were placing it in extra safe keeping. They were constantly informed that British manufacturing chemists were all on the road to the poorhouse, and some would have us believe that each day's work is only a step nearer to that unpretending but somewhat monotonous abode. It might therefore seem unsafe to give one of us paupers anything in gold; but this was not only a special honour to him, but also a valuable memorial of one of his truest and warmest friends, and he ventured to predict that it would become a most precious heirloom in his family, and they what ever Providence might have in store for them, the very last possession they would part with would be the Graham Medal which the chairman had so graciously presented to him that evening.

Mr. John Mayer, as the secretary of the Chemistry Section, desired to say a few words by way of supplementing the remarks in the note of Mr. Coleman, president of the section. He was glad to say that it was the second occasion on which he had witnessed Mr. Stanford receiving a medal for a paper dealing with his investigations into the chemistry of seaweeds. The other occasion happened some twenty-two years ago, when, being on a visit to London, he had the pleasure of attending the opening meeting of the Society of Arts for the session 1862-3. At the meeting Mr. Stanford was presented with one of the medals awarded by the council of the society for papers read in the preceding session. One of these papers embodied an account of what Mr. Stanford had done in the economic chemistry of seaweeds up till that time; and since then Mr. Stanford had received a number of other medals on account of his interesting collections of chemistry products shown at various exhibitions at home and abroad. As one of the original members of the Chemistry Section of the society, and for a long time a brother officer of Mr. Stanford in the section, he heartily congratulated him on his "Algin" paper having been so favourably regarded by Professor Crum Brown, the adjudicator in connection with the Graham Medal.

The other business before the society was then proceeded with.

NOTICES OF BOOKS.

Inorganic Chemistry. By E. Frankland, Ph.D., D.C.L., LL.D., F.R.S., and F. R. Japp, M.A., Ph.D. London: J. and A. Churchhill.

We have here a treatise which, in point of extent, stands midway between the small manuals now so numerous and the bulky works of reference for which we are indebted to the late H. Watts, to Professors Roscoe and Schorlemmer, and others. The authors tell us in their preface that their book is constructed on those principles of classification, nomenclature, and notation which have now for a considerable time been followed at the Royal School of Mines and at the Normal School of Science, South Kensington.

The introductory chapters strike us, upon the whole, as excellent. We find the sciences classified firstly under two main groups, the statical and the dynamical, and the latter are again divided into those which study changes without reference to their causes, and those "which investigate the changes which bodies undergo with special reference to the causes of such changes." This classification is more satisfactory than, *e.g.*, that of Comte, which professes to arrange the sciences in a linear order. The nomenclature adopted has this peculiarity, that the name of the positive constituent with the termination *ic* is made to precede that of the negative constituent. Thus we read in this work sodic oxide, argentic chloride, and zincic iodide, where probably most English chemists would write sodium oxide, silver chloride, and zinc iodide.

Special attention may be called to the following passage which we meet with in the chapter on the Atomic Theory. Though containing nothing novel it embodies truths too frequently overlooked, and which we are therefore glad to see enforced. Say the writers, "Sound as heard by the ear has no resemblance to the vibrations of the air; red and violet light as they affect the eye are in no way like longer and shorter waves of ether, yet this is what science tells us concerning these phenomena as they exist outside the sentient subject."

In the same chapter we find an often-forgotten caution concerning theories and their verification. "Even the atomic theory, which explains, perhaps, as many heterogeneous facts as any other theory, must not be looked upon as more than *the best existing explanation of the facts as at present known.* It may represent the absolute truth, it may be nothing more than a symbolical expression of certain aspects of the truth. . . . No number of verified predictions can establish the absolute truth of a theory."

In the chapter on the classification of the elements is a very full and careful exposition of the periodic law. We are glad to find that the claim of Newlands as the original discoverer of this law is fully admitted and ably enforced. The authors remark that "Newland's system (1864) is in all essential points identical with that of Mendeleef, published in 1869, except that Newlands failed to recognise the existence of the "transitional elements." Mendeleef's eighth group (see table, p. 74) which divide the other elements into groups of two octaves each."

We read further:—The credit of originating an idea is due solely to him who first formulates it, and this is irrespective of any subsequent development which the idea may undergo at the hands of others, provided that the central idea itself remains unaltered. No one, for example, has ever suggested that the authorship of the modern atomic theory is to be ascribed to Cannizaro instead of to Dalton because the rectification of the atomic weights was the work of the former chemist." With the view thus expressed we entirely agree. This section is enriched with a reproduction of Lothar Meyer's curve, a very useful feature. There is also mention of some recent developments of the periodic law due to Carnelley.

In concluding this chapter the authors pronounce it "quite inconceivable that the remarkable relations expressed by the periodic law should be a work of chance."

In their discussion of thermo-chemistry the authors do not unhesitatingly accept Berthelot's "law of maximum work," *i.e.*, that every chemical change, accomplished without the intervention of foreign agency, tends to the production of that body or system of bodies in the formation of which most heat is liberated. They admit, on the contrary, that "there are anomalies connected with the phenomena of the heat of neutralisation which do not appear capable of explanation on Berthelot's theory." The results of Thomsen and Ostwald are in direct opposition to Berthelot's law of maximum work. It would appear that the heat of neutralisation is directly connected not with chemical affinity but with the changes which occur in the aggregation of the solution, *i.e.*, expansion and contraction.

In their description of the elements we find tin, titanium, zirconium, thorium, vanadium, arsenic, niobium and tantalum, antimony and bismuth ranked among the non-metals. The distinction between metals and non-metals has now, however, little true scientific importance, so that the discussions which have been waged on this subject have lost their meaning.

Concerning the accuracy of the descriptions of the several elements and their compounds no question can arise. The illustrations and diagrams are numerous and very well executed. As regards the letterpress, especially the formulæ, we have not come upon any typographical errors. The work, as a whole, is highly satisfactory, and will prove very useful to the numerous class of students and general readers who have outgrown the ordinary manuals and text-books.

The Use of Horse Chestnuts as Cattle Food.—Cows are said to eat these nuts readily. With swine the experiment did not turn out well. Horse-chestnut meal contains 10 per cent of albumenoids.—*Biedermann's Centralblatt.*

The Transfer of Bacteria from the Soil to the Air.—J. Brautlecht.—Ignited sand, gravelly soil, and a moderately clayey garden soil were moistened with liquid containing bacteria and covered with glass bells. In a few hours microbia of the same kind as those contained in the liquid were found in great numbers in the moisture condensed on the sides of the bell.—*Biedermann*,

CORRESPONDENCE.

ESTIMATION OF IRON.

To the Editor of the Chemical News.

Sir,—With regard to a short note of mine (Chemical News, vol. l., p. 278) "On the Estimation of Iron by Potassic Permanganate, &c," in which the addition of magnesic sulphate is proposed in order to prevent the errors that arise when chlorides are present, Mr. W. H. Deering is good enough in your last issue to call attention to the fact that Zimmerman had previously used manganous sulphate for the same purpose. Zimmerman's earlier work, I am sorry to say, escaped my notice.

What seem to me two interesting points in Zimmerman's experiments are that, although manganous sulphate (or chloride) decomposes permanganate, its presence in considerable quantity does not vitiate the estimation of iron, and that, contrary to what I find for several other chlorides, manganous chloride should act in the same manner as the sulphate, or as magnesic sulphate.—I am, &c.,

John J. Hood.

COULOMB'S EXPERIMENTS.
A Text-book Correction.

To the Editor of the Chemical News.

Sir,—My attention has just been drawn to a communication by Mr. Joseph M. Stocks in the Chemical News of December 12, 1884, and, as I have recently had occasion to go carefully through Coulomb's own description of the experiments in question, I can clear up the difficulty encountered by Mr. Stocks. The experiment and the results to be deduced from it are given as follows on page 63 of the new edition of my "Exercises in Electrical Measurement."

Coulomb suspended a long thin bar magnet in a torsion balance, so that when there was no twist on the wire the bar was in the magnetic meridian. He then turned the torsion head through 8 right angles, when the deflection of the magnet from the meridian was 20°. He then brought the torsion head back to zero, and placed near the north pole of the suspended magnet the like pole of a long magnet. The magnet was repelled, and, in order to bring the deflection down to 17° and 12° the torsion head had to be twisted through 12 and 32 right angles respectively. Prove that the force of repulsion between the two north poles varied very nearly as the inverse square of the distance.

For angles up to 24° the sizes of the angles are proportional to those angles as far as the third place of decimals.

From the first part of the experiment we find that for a deflection of 20° the directive action of the earth on the magnet is $2 \times 360 - 20 = 700°$ of torsion, and $\therefore$ for any other angle of $x°$ it will be

$$\frac{700}{20} x = 35x°$$

From the subsequent stages of the experiment we then find that—

Angular separation of Poles.		Force on Magnet in degrees of Torsion.
24°	.. ..	$24 + 24 \times 35 = 864°$
17°	..	$3 \times 360 + 17 + 17 \times 35 = 1692°$
12°	..	$8 \times 360 + 12 + 12 \times 35 = 3312°$

$\therefore$ when the arcs were as 12 : 17 : 24 the forces were as 3312 : 1692 : 864. If the law of the inverse square had been exactly followed the forces would have been as 3312 : 1650 : 828.—I am, &c.,

R. E. Day.

48, Belsize Square, N.W.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

Biedermann's Central-Blatt für Agrikultur-Chemie,
Vol. xiii., Part 6.

The Waste Waters of Sugar (Beet) Works.—W. Demel.—The most polluted of these waters is that from the washing-machine, which contains 2·43 parts of dissolved ammonia per 100,000.

Nitrogen in the form of Nitric Acid in the Surface and Sub-soil of certain Fields at Rothamsted.—Lawes, Gilbert and Warrington.—From the *Journal of the Royal Agricultural Society.*

Researches on Farm Yard Manure.—F. P. Deherain and U. Gayon.—From the *Comptes Rendus.*

On the Formation of Farm Yard Manures.—P. P. Deherain.—From the *Comptes Rendus.*

Researches on the Best Method of Applying Manures to Beets.—Prof. A. Peterman and Wassage.—When superphosphate and nitrate of soda, with or without the addition of organic nitrogen, is applied to beets in the spring on sandy loams it should be ploughed in deeply. Harrowing in is not sufficient.

Manurial Experiments at Reims.—A. Manteau.—This paper does not admit of useful abstraction.

Influence of Stature upon the Transformation of Matter.—Dr. M. Rübner.—The experiments of Chossat, Regnault, and others, seem to show that small animals consume relatively more nutriment than large ones. The author is unable to confirm this conclusion.

The Chlorophyll Granule, considered Chemically, Morphologically, and Biologically.—A. Mayer.

A Reply to the Foregoing Paper.—A. F. W. Schimper.—The difference in the views of Mayer and Schimper consists essentially in the interpretation of the spindle-shaped leuco-plastids or anaplasts. According to Mayer these are nitrogenous reserve bodies which grow on the plastid just as do, under the circumstances, non-nitrogenous reserve-bodies, such as starch. According to Schimper the spindle is the plastide itself which has passed into a state of quiescence.

On the Share of Vegetable Acids in the Vital Turgar of Growing Organs.—Dr. H. De Fries.—A botanical paper. The author maintains that organic acids are present in every growing plant-cell.

Contributions to the Knowledge of the Chemical Process in Plants.—Prof. A. Emmerling.—Not adapted for useful abstraction.

Observations on the Movements of the Sap in the Plants of Tropical Climates.—V. Marcano.—A botanical paper.

On the Albumenoids extracted from Malt by different Waters.—E. A. Moritz and A. Hartley.—From the *Brewers' Guardian.*

MEETINGS FOR THE WEEK

Monday, 5th.—London Institution, 5.
—— Medical, 8.30.
—— Society of Chemical Industry, 8. Discussion on the Proposed Rivers' Pollution Bill. "Cellulose and Hydration," Messrs. Cross and Bevan. "The Commercial and Manurial Value of Filter-pressed Sewage Sludge," Professor Munroe.
Tuesday, 6th.—Royal Institution, 3. "The Sources of Electricity," by Professor Tyndall.
—— Photographic, 8.
Thursday, 8th.—London Institution, 5 and 7.
—— Royal, 4.30.
—— Royal Institution, 3. "The Sources of Electricity by Professor Tyndall.
Friday, 9th.—Quekett Microscopical Club, 8.
—— Astronomical, 8.

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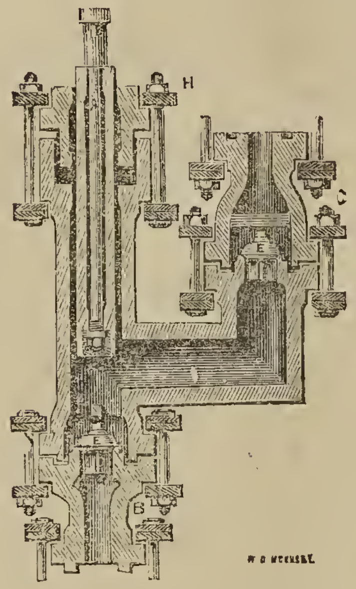

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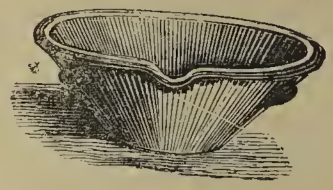

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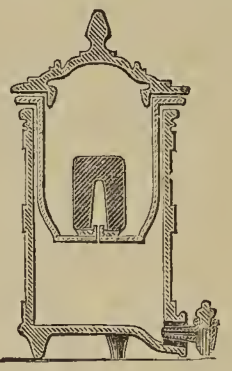

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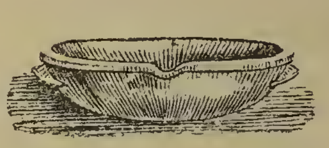

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ON THE SYNTHESIS OF TRIMETHYLAMINE AND PYRROL FROM COAL-GAS;

AND ON THE

OCCLUSION OF HYDROGEN BY ZINC DUST.

(Preliminary Notice).

By GREVILLE WILLIAMS, F.R.S.

In a paper on "The Action of Some Heated Substances on the Organic Sulphides in Coal Gas,"[*] I mention that on passing coal gas that had not been purified by lime, over palladised pumice at a temperature considerably below a red heat, ammonia and distinct traces of a volatile alkaloid were formed. The palladium was charged with hydrogen by passing the coal gas over it at about 212° F. At this temperature palladised pumice absorbs hydrogen from the coal gas; and, at a higher temperature, gives it off in such a condition as to react upon the vapour of cyanides and produce ammonia and a volatile alkaloid. When the palladium ceased to act—that is to say, when ammonia and the alkaloid no longer continued to be formed—the tube containing the palladised pumice was transferred to a trough of boiling water, and the current of gas was kept up until the metal had become active; that is, charged with hydrogen. The water-bath was then removed, and the tube was heated by a very small gas-flame, when the formation of ammonia and the alkaloid again commenced. The quantity of the latter formed from 250 grains of palladised pumice containing 20 per cent. of palladium was, however, so small that I could not procure enough for analysis.

Having found that zinc dust heated to a low temperature in a current of coal gas rendered hydrogen active in a similar way to palladium, I determined to ascertain if, by using a much larger quantity than I had of palladised pumice, the synthesis could be effected on a sufficient scale to enable me to analyse the products. For this purpose I used the following simple apparatus:—A globular flask was fitted with a cork carrying two tubes, one of which passed to within a half-inch of the bottom; and, at its lower extremity, was protected by a cage of fine copper gauze, to prevent it from being stopped up by the zinc dust. The flask was then filled with the latter to the commencement of the neck. The gas passed through the zinc dust with the greatest ease.

Experiment 1.—The flask arranged in the manner described was heated with a small rose burner; and, when the temperature arrived at about 400° F., sulphuretted hydrogen was evolved, accompanied by the same peculiar odour that was observed when using palladised pumice. When a rod moistened with hydrochloric acid was brought near the exit, it fumed strongly. The odour was like that of fish. On holding a piece of fir wood moistened with hydrochloric acid in the vapour, the red reaction characteristic of pyrrol was distinctly obtained. The vapour was now passed into dilute hydrochloric acid during the night, and in the morning a scarlet ring was formed on the sides of the beaker about ¾ inch above the solution. This was probably pyrrol red produced in the well-known manner by decomposition of the pyrrol by the acid.

Experiment 2.—After the preliminary experiment just described, 19 feet of the gas were passed as before; but the products were conveyed into a Geissler's potash-tube containing hydrochloric acid diluted with twice its volume of distilled water. The product was evaporated to dryness; the chloride of ammonium and tarry matters removed; and the hydrochlorate of the base, which was very deliquescent, was converted into a platinum salt. It weighed 2·7 grains. The smallest trace of this platinum salt gave the fingers an intensely fishy odour. From its great intensity I inferred that the alkaloid was not methylamine, as when working with palladised pumice I, at one time, thought it might be, remembering Dr. Debus's synthesis of that base by the action of platinum black on prussic acid.[*] The platinum salt produced in this experiment was not analysed, but reserved for further purification.

Experiment 3.—The current was kept up for twelve hours, during which 21·51 feet of gas passed. At this point the flask cracked. On cooling it was broken up, and it was found that the zinc had partly melted. On treating it with dilute sulphuric acid, sulphuretted hydrogen was evolved. The platinum salt weighed 4·7 grains. It yielded on ignition 38·83 per cent. of platinum. The corresponding salt of methylamine requires 41·61 per cent.; that of dimethylamine requires 39·53; and that of trimethylamine 37·20. It is not unlikely, however, that traces of methylamine, or dimethylamine, or both, were present. It should here be noticed that the errors tend in the direction of too much platinum, owing to the difficulty of removing the last traces of ammonium salt when working on such minute quantities. It was found that ammonia and traces of the alkaloid were formed in this experiment when the zinc dust was cold; but this was not always the case. At 202° F., the fumes with hydrochloric acid were more obvious; at 226° they were observed the instant the rod dipped in the acid was brought near the exit tube. At 242° the fumes were very briskly evolved; and no apparent increase was noticed up to 356°.

Experiment 4.—The gas was passed for 17 hours in the cold, to hydrogenate the zinc; and 7 hours with heat. The chloride of ammonium produced weighed 15 grains; the platinum salt amounted to 7·7 grains. On ignition it gave 38·40 per cent. of platinum, or nearly the same as in Experiment 3. The gas passed amounted to 100 feet.

Experiment 5.—Here 101 feet of gas gave 2·03 grains of platinum salt; containing 37·04 per cent. of platinum. This only differs by 0·16 per cent. from the number required by theory for trimethylamine. The sal ammoniac formed amounted to 6·2 grains.

Experiment 6.—The volume of the gas used was not taken. Two precipitates of platinum salt were obtained. The first was put aside to be worked up afterwards with some others to obtain greater purity. The second weighed 7·2 grains and afforded 38·47 per cent of platinum. The chloride of ammonium weighed 1·9 grains.

Experiment 7.—This time 42 feet of gas were passed. Two crops of crystals of platinum salt were obtained, weighing together 8·0 grains. The mixture yielded 38·05 per cent. of platinum; and 2·1 grains of chloride of ammonium were obtained.

In some of the foregoing experiments the whole of the platinum salts were not used in the determinations of the metal. The portions left were therefore mixed, distilled with soda, and the distillate received in hydrochloric acid. The solution was evaporated to dryness, traces of chloride of ammonium were removed, and the solution treated with a very small quantity of platinic chloride. The solution was then allowed to repose until next day; and the platinum salt formed was filtered off and rejected. The filtrate was treated with more platinic chloride dissolved in alcohol. A copious precipitate was obtained. On analysis it gave 14·16 per cent of carbon, 3·79 of hydrogen, and 37·81 of platinum. Trimethylamine requires 13·57 per cent of carbon, 3·77 of hydrogen, and 37·20 of platinum. The following is a summary of the above results:—

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[*] *Journal of Gas Lighting*, vol. xli., pp. 913, 960.

[*] *Journ. Chem. Soc.*, 1863, p. 249. See also T. Fairley, "On the Action of Hydrogen on Organic Polycyanides," *Journ. Chem. Soc.*, 1864, p. 362.

No. of experiment.	Gas used.	Platinum Salt obtained.	Alkaloid obtained calculated as Trimethylamine. Grains.	NH_4Cl obtained. Grains.	Platinum per cent in Salt.
1.	—	—	—	—	—
2.	—	2·70	0·6	—	—
3.	21·51	4·70	1·0	—	38·83
4.	100·00	7·70	1·7	15·0	38·40
5.	101·00	2·03	0·5	6·2	37·04
6.	—	7·20	1·6	1·9	38·47
7.	42·00	8·00	1·8	2·1	38·05
Mixture	—	—	—	—	37 81

The mean percentage of platinum is 38·10, which is 0·90 per cent too high for trimethylamine, and 1·43 per cent too low for dimethylamine. As the errors of experiment tend to give too high a number for the platinum, I conclude that the base formed was principally trimethylamine. It might also be propylamine, which requires the same numbers, and be formed from cyanide of ethyl as in Mendius's well-known process. Such a supposition, however, does not account for the ammonia formed at the same time—$C_2H_5CN + 2H_2 = C_3H_9N$. But, as the ammonia formed simultaneously with the base is in such large excess, further experiments are necessary to explain all the phenomena. The base butylen-diamine, obtained by Fairley from cyanide of ethylene, requires 9·59 per cent of carbon, 2·80 of hydrogen, and 39·45 per cent of platinum;[*] and, moreover, would not have the characteristic smell of trimethylamine.

If we assume that the base is formed from prussic acid, the equation becomes: $3CHN + 6H_2 = C_3H_9 + 2NH_3$. The production of sal ammoniac in the experiments was too irregular to enable this equation to be confirmed from its amount.

According to Lange[†] a polymeride of prussic acid exists having the formula $C_3H_3N_3$. If formed from this substance the equation is the same as that given above.

It appeared to me that some light might be thrown upon the question if hydrogen instead of coal gas were passed through hydrocyanic acid and then into heated zinc dust; because, if in that case I obtained a number for the platinum in the salt nearer to methylamine, it would show that the formation of trimethylamine from coal gas did not arise from a peculiarity in the action of the zinc, but from the substance in the gas which gave the alkaloid not being ordinary hydrocyanic acid.

Experiment 8.—Hydrogen prepared from zinc and dilute sulphuric acid was passed through a warm acidulated solution of cyanide of potassium for one day, after a previous passage during the night to render the zinc active. The resulting alkaloid was converted into platinum salt, and weighed 3·20 grains. It gave on ignition 42·59 per cent. of platinum. The platinum salt of methylamine requires 41·68. Error + 0·91. The chloride of ammonium amounted to 24·1 grains. It is by no means easy to completely separate so small a quantity of methylamine from so much ammonia; and the excess of platinum is probably due to this cause. The 24·1 grains of chloride of ammonium contained 7·6 grains of ammonia, whereas the 3·20 grains of platinum salt of methylamine only contained 0·41 grain of the alkaloid, or less than half a grain. The equation $CHN + 2H_2 = CH_5N$ does not involve the formation of any ammonia. If we suppose the base to be formed from cyanogen, we have, of course, $C_2N_2 + 5H_2 = 2CH_5N$, which also dispenses with the formation of ammonia.

The smallness of the quantity of alkaloid formed in the reaction—only amounting to 7·2 grains in the six experiments in which it was estimated—would have prevented me from carrying out this preliminary investigation if I had not, fortunately, had much previous experience in working on minute portions of these substances. The substance or substances which yield ammonia and pyrrol are not entirely removed by treating the gas with lime; as I found in one experiment that, on passing well purified gas over heated zinc dust rendered active, turmeric paper was reddened and pyrrol evolved.

The source of the pyrrol I hope to clear up by future experiments; but I may mention that I found, in 1855, that it is formed in numerous cases when nitrogenous animal and vegetable matters are subjected to destructive distillation.[*]

I must not omit to state that, having on one occasion treated zinc dust with very dilute sulphuric acid, with a view to its purification, the washed and dried product refused to act upon the gas in the manner described in the foregoing experiments. I propose to return to this question.—*The Journal of Gas Lighting.*

TOUGHENING (PURIFICATION) OF GOLD (SILVER, &c.), IN THE CRUCIBLE.

By JAMES C. BOOTH, Ph.D., Melter and Refiner, U.S. Mint.

In all operations in the Arts, economy, especially the avoidance of needless wastage, is of importance, in direct proportion to the value of the material operated on.

While a loss of 10 per cent may be and is tolerated in working iron in the fire, the United States Government holds the officers of Mint responsible, in working gold, for any wastage beyond 0·001 ($\frac{1}{10}$ of one per cent), and in silver beyond 0·0015. In practice, the actual loss is usually far within that range. In general, the tolerance of loss, in working the metals, is inversely as their commercial value.

The recent progress of knowledge and skill, in the Arts, is well shown in the improved commercial character of some of the commoner metals. When I first examined the copper of commerce, in 1850, with reference to its use for minor coinage, or for alloying gold and silver coin, I found that a large amount of the best commercial article contained about 98 per cent copper, and that it often made hard or brittle alloys. We now employ copper averaging 99 per cent pure, with small quantities of nickel, silver, oxygen, silica, and the usual intruder into everything on earth, iron. In a few instances, 50,000 lbs. of extra refined copper (from Pope, Cole, and Co., Baltimore, Md.), yielded to a specially fine analysis (by Booth, Garrett, and Blair), about $99\frac{3}{4}$ per cent copper. In like manner, a remarkable change has occurred in the silver market. About 1850, the best commercial silver usually assayed 99 per cent, and in 1853 I took credit in exhibiting a pile of about ten tons of silver that averaged nearly $99\frac{5}{10}$ per cent. At the present time, a large amount of the good silver of commerce, from the mining regions, averages $99\frac{9}{10}$, and sometimes attains $99\frac{95}{100}$; failing only by $\frac{5}{10000}$ of absolute purity.

The gold of commerce generally requires toughening, or purifying, to fit it for coinage, or jeweller's use, as it consists of bars, with silver, somewhat improved by melting,—of lumps and grains of ore,—and of old jewel-

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[*] Fairley, *loc. cit.*, 363.

[†] *Deut. Chem. Ges. Ber.*, vi., 99.

[*] *Trans. Roy. Soc. Edin.*, xxi., part 2.

lery, containing tin, lead, zinc, and all the cheap elements that ingenuity, greed, and deception can use to dilute and cheapen the precious metal, without wholly obliterating its coveted yellow colour, and its toughness. Some really tasteful jewellery, of fair quality to the eye, which chooses to judge for itself, contains only one-fourth of gold, and some still less.

The lumps and grains are melted to drive off mercury, &c., and are then refined, together with good silvery bars, by acid processes, termed quartation or parting. Where tin is present, as in jewellery, the nitric acid process is preferable, and after thoroughly washing out nitrates, muriatic acid, drenching the residue, dissolves out the tin, and the residue is pure gold. Iron is a frequent enemy to the ductility of gold, an extremely small percentage rendering it hard or brittle, as in the case quoted in *Journ. Amer. Chem. Soc.*, vi., 182. The principle, there developed, is to remove all the embrittling elements, with the least practicable quantity of the valuable metal, on one side (to be subsequently purified); and on the other, to have all the rest of the gold practically pure. The loss of gold, in the fire, is in proportion to the length of exposure and to the quantity exposed; and the process described eminently guards these points. A single practical illustration will make the principle clear. Suppose a melt of 5000 ozs. of gold, containing 0·001 (5 ozs.) embrittling impurity, is separated, by a short working in the fire, into 100 ozs. skimmed off impurity (consisting of 95 ozs. gold, and 5 ozs. embrittling matter, together with flux), and 4900 ozs. practically pure gold; then only 95 ozs. are exposed to further possible wastage in the fire.

Toughening, or Purifying, Silver from Lead, &c.

The principles, and to some extent the practice, above applied to gold, may be applied to silver, adulterated with lead, tin, zinc, &c.

In spite of the great improvements in preparing silver bars for the market, as noted above, we often received them alloyed with lead, &c., and quite unfit for coinage, some ten or fifteen years ago. Recently they have generally been unexceptionable. There was no reason for having inferior silver in the market, because the Western smelters then had cupels, and knew how to use them, but the lower price of the inferior silver was an irresistible temptation to a purchaser. I bore the brunt of the mistaken purchase, for the question given to me for solution was, to refine a few tons of plumbic silver without a cupelling hearth; for even if I had desired one, there was no room for its erection in the Mint. Since I solved the question successfully, and by a rather novel method, it seems to be worth describing. At one time I smelted a lot of some 50,000 ozs. of commercial silver bars, in melts of about 3500 ozs. each, and treated each melt in the same way, as follows:—It was melted with the addition of about an ounce or more of anhydrous borax, which greatly facilitates fusion, and, to a limited extent, prevents volatilisation, although forming only a paper-thick covering to the melted metal. A covering of bone-ash ($\frac{1}{8}$ to $\frac{1}{4}$ in. thick), having been sprinkled over the surface, crystals of soda-nitre are here and there dropped through the covering, and after effervescence has somewhat progressed, a black-lead dipper, held in the tongs, is moved around the top, in interlacing circles, to spread the oxidation, and the metal is then more thoroughly mixed by plunging the dipper to the bottom of the metal, moving it up and down, once or twice, and, after lifting it out full, by pouring it back into the metal. This operation of oxidising throughout is advantageously repeated, and more than once if the silver is known to be foul with lead. All these operations being rapidly performed, the surface is hastily skimmed by a triangular crucible (so as to have always a flat side for skimming), experience guiding the melter to take off all the fluxed matter, with as little silver as is conveniently practicable. The whole time of oxidation and skimming is of but a few minutes duration, so that no chance is given to the oxidised metals to revert to the metallic condition in the presence of their tempters, carbon and melted metal. The processes of oxidising and skimming are repeated until the *look* of the remaining silver, or the test of a cast strip, proves sufficient purity of metal. In the case here specially noted, the working of 12 melts occupied between one and one-and-a-half days to resolve them into over 49,000 ozs. of silver sufficiently pure and tough for coinage, and less than 1000 ozs. of silver, with litharge, and other oxides, in the skimmings. These last consist of bone-ash, cemented by litharge, borax, and alkali, into mixed soft and hard sponge, or brick, with some grains of silver entangled in the mass.

The treatment of the skimmings constitutes the chief, and I believe novel, peculiarity of the process. The whole residues having been charged into pots, with the addition of some charcoal, to aid in reducing the litharge, and of pearlash, to make the slags thinner, was melted in a covered crucible at a full red heat, and allowed to cool quietly, so as to make a king of all the reduced metal with a cinder or slag above it. When cold, the slag and cinders were ground and sifted to recover metallic grains. The cold kings were put into a crucible and gradually heated by a long continued heat from below the melting-point of lead to a full red heat, and the eliquated metal at different heats collected separately. The first runs were nearly pure lead, so as to be cut with the same facility as the soft lead of commerce.

There was only a slight wastage of silver in all the above operations, and but little loss of lead. I found the whole process a very short method of procuring nearly the whole of the silver from its obstinate alloy with lead, and attended with a trifling wastage; and I have good ground for believing that a little experimental practice might easily lead to its further improvement, so as to be substituted for cupelling, where the latter is not convenient. The depressed hearth of a reverberatory might readily be used as the black-lead crucible, and other modifications devised according to the exigencies of the case. These remarks are not designed to disparage the admirable process of cupellation, but merely to show that we are not necessarily confined to the last. In fact, the process I have indicated *is* cupellation, with a movable cupel, and oxy-salts used instead of a blast.

It is hardly worth drawing the plain conclusion that where lead is thus removed from silver, zinc, tin, antimony, &c., will be oxidised at the same time, and caught either in the metallic residues (kings), or as oxides in the cinders. So efficient, economical, and easy of execution is the process, that one leaps to the conclusion that where silver contains one or more of the above oxidisable metals lead may be added, and the whole worked off with ease. Direct trial has proved it.

Purification of Phosphor-Bronze.

The question having been propounded to me about a year ago by a worker in copper alloys, of removing the phosphorus from phosphor-bronze, I applied the principle herein developed, of using the greater oxidisability of the phosphorus and skimming it off, with a cover of lime on the melted metal. Although I had the time of but a half day to test the process, and in spite of no previous experience in skimming, I succeeded so far as to prove that a simple and effectual process can readily be evolved from the hints I have given in this paper.—*Journal of the American Chemical Society.*

The Decomposability of Potassium Iodide.—Aug. Vogel.—On heating potassium iodide with silica, iodine is expelled in large quantities. Whether the decomposition is so complete as to afford a means for the determination of iodine the author has not decided. Potassium iodide is decomposed if heated alone to 180° or upwards. At first oxygen is taken up, and potassium iodate is formed, but at higher temperatures iodine escapes.—*Zeitschrift.*

ZINC IN DRINKING WATER.

By F. P. VENABLE, Ph.D.

THE increase in the use of galvanised iron, especially in the form of water tanks and pipes, has lead to a re-opening of the question as to the possible injurious effects from the use of such water. It is a matter of importance then to us how far our knowledge extends on this subject, and I will collect here all of the known facts so far as I have been able to get at them.

The so-called galvanised iron is of course nothing more than iron dipped in a bath of zinc and so superficially coated with it and to a certain extent alloyed with it. The character of the protection afforded the iron is galvanic (hence the name), the two metals forming a galvanic couple, so that under the action of any exciting liquid the zinc and not the iron is attacked. That zinc dissolves in potable waters has long since been shown by the experiments of Boutigny, Schaueffele, and Langonnê. Distilled water and rain water dissolve it more readily than hard water. Especially is water containing carbonic acid capable of this solvent action. So much may be taken up that the water becomes opalescent and acquires a distinctly metallic taste. It seems that by the action of water, hydrate and carbonate of zinc are gradually formed, and that this action is more rapid in the presence of certain saline matters, but is weakened by the presence of calcium salts.

As to the injurious effect of such waters, authorities differ. Fonssagrives has investigated the question, consulting the statistics of the French Navy and the recorded experiments of others, adding, however, none of his own. The French Government had, before this, appointed a committee to make a special report on the subject, and the investigations of Roux in 1865 and 1866 furnished evidence enough of possible injury to health from water stored in galvanised iron tanks to lead to an order from the Minister of Marine, prohibiting the use of such tanks on board of ships of war. Boutigny attributed grave effects to the use of these zinc-containing waters, looking upon it as probably resulting in epilepsy. Fonssagrives, however, maintains that the zinc is not cumulative and produces no bad effects unless taken in large doses. Doubt is thrown on this position, however, by the fact that his assertions as to the limited solubility of zinc in ordinary drinking-water are not sustained by experiments. Without doubt such waters have been used for considerable lengths of time and no injurious effects have been noticed. This may have been due, however, to the hardness of the water, and hence the small amount of zinc dissolved. Pappenhein states in contradiction to the assertion of Fonssagrives that zinc vessels are dangerous and must be carefully avoided. Dr. Osborne, of Bitterne, has frequently observed injurious effects from the use of waters impregnated with zinc. Dr. Stevenson[*] has noticed the solvent action of rain-water on galvanised iron and states that probably its continued use would cause injury to health. He recommends as a convenient test for the presence of zinc] in potable waters, the addition of potassium ferrocyanide to the filtered and acidulated water. Zinc gives a faint white cloud or a heavier precipitate when more is present. Dr. Frankland[†] mentions a case of zinc poisoning where well-water, containing much dissolved oxygen and but little carbonic acid, was used after passing through galvanised iron pipes. Professor Heaton[‡] has recorded the analysis of a spring water in Wales, and a second analysis of the same water after passing through half a mile of galvanised iron pipe, showing that the water had taken up 6·41 grains of zinc carbonate per gallon.

A similar instance of zinc-impregnated water has come under my own observation, and I append the analytical results. The water from a spring 200 yards distant was brought by galvanised iron pipes to a dwelling-house and there stored in a zinc-lined tank which was painted with white-lead. The water became somewhat turbid and metallic-tasting and its use for drinking purposes was discontinued. Analyses were made after the pipes had been in use about one year. A somewhat full analysis of the spring water was made under my direction by Mr. J. C. Roberts. The analyses of water from the tank and directly from the pipe I carried out only so far as zinc, iron, and tests for lead were concerned. The results are calculated in grains per gallon of 231 cub. in.:—

Analysis of Spring.

Silica..	2·45	grains.
Lime	0·23	,,
Magnesia	0·17	,,
Alkalies	0·43	,,
Chlorine	0·35	,,
Sulphuric acid..	0·19	,,
Carbon dioxide (calculated)	0·45	,,
Total residue on evaporation ..	4·34	,,

The tank contained 4·48 grains of zinc carbonate per gallon with a trace of iron and no lead. Water from the pipe gave 4·29 grains of zinc carbonate per gallon and a trace of iron.

It is evident then, when the dangerous nature of zinc as a poison is taken into consideration, that the use of zinc-coated vessels in connection with water or any food-liquid should be avoided.—*Journal of the American Chemical Society.*

A SIMPLE SALT FOR OPENING UP SILICATES.

By CARL HOLTHOF.

IN opening up silicates it is not merely important to obtain the mineral in a uniform state of fine division by pulverising, sifting, &c., but the agent used in the process must be as far as possible free from moisture, and must admit of an equable commixture with the silicate.

The mixture of sodium and potassium carbonate generally used for this purpose has the defects of containing traces of silica and alumina, of a granular texture and of deliquescence.

Commercial sodium bicarbonate, on the other hand, is as pure and as convenient a material as can be desired. It is readily reduced to an impalpable powder which is not hygroscopic; unless heated too abruptly it gives off its constitutional water and its second mol. of carbonic acid without the projection of dust, even at a somewhat low temperature, leaving the mono-carbonate as a dense powder. This fact induced the author to heat the mixture of silicate and of bicarbonate directly in the crucible. He considered, further, that the base at the moment of its liberation from the carbonic acid, &c., must have an intensified affinity for the silica in the mineral, so that if the two materials are intimately mixed in the state of impalpable powders a chemical combination between the two must take place, even below the fusion-point of the mass. This view was verified by experiment.

The author proceeds as follows:—According to the nature of the material, 12 to 15 parts of finely ground bicarbonate are used to 1 part of the most finely ground silicate. A scanty fourth part of the bicarbonate is put in the bottom of the crucible; a good fourth is placed in a small warmed capsule, and most intimately mixed with the powdered silicate: the mixture is laid upon a sheet of glazed paper, where it is mixed with another fourth of the bicarbonate, and then introduced into the crucible. With the rest of the bicarbonate, the capsule and the paper are rinsed into the crucible. The well-covered cru-

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[*] CHEMICAL NEWS, xlix., 107.

[†] *Ibid.*, xlix., 115.

[‡] *Ibid.*, xlix., 85.

cible, which may be half full, is heated at first carefully over a moderate flame till the bottom is faintly red. In the next quarter of an hour the flame is increased very gradually until the lower half of the crucible is at a dull red-heat. In the next quarter of an hour it is raised to full ignition, without letting the contents melt. Not until afterwards the mass is fused, and allowed to flow quietly. If a Muencker or a Stockmann burner is employed, the use of a blast is not needful. A drop of the melt is very rarely found adhering to the lid of the crucible.—*Zeitsch. f. Anal. Chemie.*

DETERMINATION OF PHOSPHORIC ACID IN FERTILISERS.*

1. THE sample should be well intermixed and properly prepared, so that separate portions shall accurately represent the substance under examination, without loss or gain of moisture.

2. *Water-Soluble Phosphoric Acid.*—Bring 2 grms. on a filter; add a little water; let it run out before adding more water, and repeat this treatment cautiously until no phosphate is likely to precipitate in the filter. (The washings may show turbidity after passing the filter.) When the substance is nearly washed in this manner, it is transferred to a mortar and rubbed with a rubber-tipped pestle to a homogeneous paste (but not further pulverised), then returned to the filter and washed with water until the washings no longer react acid with delicate test-paper. Mix the washings. Take an aliquot (usually corresponding to one-third or one-half of a gramme of the substance), and determine phosphoric acid as under Total Phosphoric Acid.

3. *Citrate-Insoluble Phosphoric Acid.*—Wash the residue of the treatment with water into 150 c.c. flask with 100 c.c. of strictly neutral ammonium citrate solution of 1·09 density; shred and add the filter-paper; cork the flask securely; place in a water-bath with constant temperature of 65° C., and digest for thirty minutes with frequent shaking. Filter the warm solution quickly, and wash with water of ordinary temperature.†

Transfer the filter and its contents to a porcelain capsule. Ignite until the organic matter is destroyed; treat with 10 to 15 c.c. of fuming hydrochloric acid; digest over a low flame until the phosphate is dissolved; dilute to 200 c.c.; mix; pass through a dry filter; take an aliquot, and determine phosphoric acid as under Total.

4. *Total Phosphoric Acid.*—Weigh 2 grms. into a capsule, add and mix intimately with 4 to 7 c.c. of a nearly saturated solution of magnesium nitrate, dry; ignite gently; if necessary, moisten the residue with nitric acid and ignite again to destroy all organic matter; add to the residue 15 to 20 c.c. of fuming hydrochloric acid; digest at a gentle heat until all phosphates are dissolved; dilute to 200 c.c.; mix; pass through a dry filter; take 50 c.c. of filtrate; neutralise with ammonia; add about 15 grms. dry ammonium nitrate, and to the hot solution, for every decigramme of P_2O_5 that is present, 50 c.c. of molybdic solution. Digest at about 65° C. for one hour; filter and wash with ammonium nitrate solution. (Test the filtrate by renewed digestion and addition of more molybdic solution.

Dissolve the precipitate on the filter with ammonia and hot water, and wash into a beaker to a bulk of not more than 100 c.c. Nearly neutralise with hydrochloric acid; cool, and add magnesia mixture from a burette, slowly (one drop per second), and stirring vigorously. After fifteen minutes add 30 c.c. of ammonia solution of density 0·96. Let stand several hours. (Two hours are usually enough.) Filter; wash with dilute ammonia; ignite intensely for ten minutes, and weigh.

5. *Citrate-Soluble Phosphoric Acid.*—The sum of the water-soluble and citrate-insoluble subtracted from the total gives the citrate-soluble.

PREPARATION OF REAGENTS.

1. *To Prepare Ammonium Citrate Solution.*—Mix 370 grms. of commercial citric acid with 1500 c.c. of water; nearly neutralise with crushed commercial carbonate of ammonia 410 grms.; heat to expel the carbonic acid; cool; add ammonia until exactly neutral (testing for excess both of acid and alkali by aid of delicate red and blue litmus papers), and bring to volume of 2 litres. Dilute further until the density is 1·09 as tested by the balance or *accurate* specific gravity spindle.

2. *To Prepare Solution of Magnesium Nitrate.*—Dissolve 320 grms. of "calcined magnesia" in nitric acid, avoiding excess of the latter; then add a little "calcined magnesia" in excess and boil; filter from the excess of magnesia, ferric oxide, &c., and bring to volume of 2 litres.

3. *To Prepare Molybdic Solution.*—Dissolve 100 grms. of molybdic acid in 400 grms., or 417 c.c. of ammonia of sp. gr. 0·96, and pour the solution thus obtained into 1500 grms. or 1250 c.c. of nitric acid of sp. gr. 1·20. Keep the mixture in a warm place for several days, or until a portion heated to 40° C. deposits no yellow precipitate of ammonium phospho-molybdate. Decant the solution from any sediment, and preserve in glass-stopped vessels.

4. *To Prepare Ammonium Nitrate Solution.*—Dissolve 200 grms. of commercial ammonium nitrate in water, and bring to a volume of 2 litres.

5. *To Prepare Magnesia Mixture.*—Dissolve 22 grms. of recently ignited "calcined magnesia" in dilute hydrochloric acid, avoiding excess of the latter. Add a little "calcined magnesia" in excess, and boil a few minutes to precipitate iron, alumina, and phosphoric acid; filter; add 280 grms. of ammonium chloride, 700 c.c. of ammonia of sp. gr. 0·96, and water enough to make the volume of 2 litres. Instead of the solution of 22 grms. of "calcined magnesia," 110 grms. of crystallised magnesium chloride ($MgCl_2.6H_2O$) may be used.

6. *Dilute Ammonia for Washing.*—One volume ammonia of sp. gr. 0·96 mixed with 3 volumes of water, or, *usually*, 1 volume of concentrated ammonia with 6 volumes of water.

THE FUSION, CASTING, DEPHOSPHORISING, AND PLATING OF IRIDIUM, TOGETHER WITH A BIBLIOGRAPHY OF THE SUBJECT.

By NELSON W. PERRY, E.M.

(Continued from page 5.)

Now this fused phospho-iridium possesses some peculiarities of its own. In the first place it is considerably harder, sometimes reaching 9; retains perfectly its metallic character; is somewhat lighter, due to the addition of phosphorus and increase in bulk; but is not perceptibly more brittle, as might be inferred. As stated, it has materially increased in bulk, but retains its homogeneity, with perhaps an increase of capacity for polish, and forms some alloys that the mineral itself is incapable of.

It alloys in small quantities with silver, forming the most elastic and hardest known alloy of that metal. With gold and tin no alloys have been made.

With zinc, in the presence of ammonium chloride, it acts in the same way as does iridosmine.

With copper it unites in varying proportions, giving a very hard brittle alloy. With very small quantities of phospho-iridium a box-metal is produced admirably suited

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* Methods adopted by the Association of Official Agricultural Chemists, for use during the season of 1884-5.

† This filtration should not exceed fifteen to twenty minutes in duration, and in difficult cases is best effected by use of a plaited filter of very porous paper, or by help of a filter-pump of *moderate* power.

for applications where the bearing surfaces are subjected to intense pressure, as in drill presses, &c. It seems to possess the property of retaining the lubricant between the rubbing surfaces, under conditions of great pressure, better than any other metal, and, being hard, resists distortion and wears much better.

With iron, nickel, cobalt, and platinum it forms alloys, seemingly in all proportions, and of the greatest importance.

With iron, whose alloy has been the most studied, it unites in all proportions, giving a product retaining the properties of pure phospho-iridium to a lesser degree as regards incorrosibility, and hardness only perceptible after large proportions of iron have been added. Slight magnetism begins to make its appearance almost at once, but the alloy is unaltered by acids and alkalies, and its hardness is such as to turn the best file until the iron reaches 50 per cent. From this point on the alloys become less and less refractory, partaking more of the qualities of iron, but remaining always brittle.

In casting, the more complex shapes are cast in iron or steel moulds, either open or closed (previously heated to prevent too rapid cooling or chilling of the phosphide), or are subsequently sawed out of slabs previously cast. It is found that one melting of the phosphide is usually not sufficient, and that sharper and better casts are obtained after repeated meltings, up to a certain point. At each melting, however, some of the phosphorus is volatilised, requiring at each succeeding firing a higher temperature for fusion. A certain point is at last reached, discernible only to the practised eye, when the metal will take the most perfect cast. If carried beyond this point its capacity in this direction diminishes, and, if carried far enough, the metal becomes again infusible at the temperatures attainable. Should this stage be reached, the metal can be returned to its fusible condition by addition of more phosphorus.

We have now a cast or slab of iridium combined with phosphorus: the next step is to remove the latter.

Though Prof. Dudley states that this is accomplished with the aid of a lime crucible and the electric furnace, the first method employed was as follows:—A piece of perforated fire-clay is fitted into the bottom of a Hessian crucible so as not to quite touch the bottom. Upon this is placed the cast to be dephosphorised, carefully packed in dry powdered lime. The crucible with its contents is now heated, and kept at a good cherry-heat for some time. The phosphorus unites with the lime, forming a dirty, greenish, semi-translucent slag (phosphate of lime?), which, as fast as formed, runs down through the perforations in the fire-clay, and collects in the bottom of the crucible After a certain time the crucible is removed, cooled, the cast taken out, and re-packed in similar manner in another or the same crucible, and again heated as before. This is repeated a number of times, the temperature being increased at each succeeding heat until it is deemed sufficiently dephosphorised.

Although Mr. Holland's offer of 1000 dollars failed to bring him one ounce of fused iridium, he has by his process fused over 30 ounces at *one* heat, in a Hessian crucible *with a natural draft* furnace. Larger melts could be made, but thus far have not been attempted.

On May 10th, 1881, Mr. Holland took out letters patent for the fusion of iridium with phosphorus, and a few months later took out patents covering all alloys with other metals.

At about this time a Company was formed, known as "The American Iridium Company," with head-quarters and factory in Cincinnati. Of this Prof. Dudley was elected general manager, and to him is largely due the present state of perfection of the new industry. He immediately set himself to work to extend the applications and usefulness of the practically new metal in the arts. His thoughts naturally early turned to electro-plating. He was experimenting in an entirely new field, with no precedents to go by except those furnished by the electro-metallurgy of the other metals, so different in kind. It is not surprising, therefore, that he made many failures, and that his progress was slow; but it has been nevertheless sure.

With a slightly acid solution of the double chloride of sodium and iridium, and a phospho-iridium anode, he succeeded in getting a fine reguline deposit on copper and some other metals as a base. This is capable of the highest polish, and in colour I should place it between polished steel and nickel, though some specimens are so white that they might be placed between nickel and silver. At first it was found possible only to make a very *thin* plate. This would at times scale off, and at others, after long standing, become discoloured by the foundation. The latter, too, to be kept at its normal strength, required constant additions of the soluble salt, the metal being deposited faster than the anode was dissolved. He has later, however, discarded this method, employing an entirely different anode and electrolyte, and has completely overcome the previously mentioned difficulties. The deposit can now be made heavy, and his bath remains constant. The principles involved are doubtless applicable to the electro-metallurgy of gold, silver, platinum, nickel, and copper, which are now subjects of experiment.

Prof. Dudley has applied for patents covering his inventions in electro-plating, but they have not yet been issued. For obvious reasons, therefore, I cannot give the details without violating confidence.

Prof. F. W. Clarke and Mr. O. T. Joslin early made a series of analyses of the phospho-iridium, with exceedingly interesting results. The subjects analysed were some fused phospho-iridium and some of the original iridosmine from California, from which the phospho-iridium was made.*

The sp. gr. of the irodosmine was found to be 19·182; that of the phospho-iridium, 13·763.

Three estimations for phosphorus in one sample of the latter gave 7·52, 7·58, and 7·74 per cent. The sample contained barely a trace of osmium.

In the iridosmine itself 15·38 per cent of osmium were found. A second fused portion gave—

	Per cent.
Iridium	80·82
Osmium..	6·95
Phosphorus	7·09
Ruthenium and rhodium	7·20
	102·06

From these results they conclude that the fused iridium is a definite phosphide, having the formula Ir_2P. For this formula the percentage of phosphorus should be 7·43; the difference they account for by the presence of other metals, and adduce, in support of its correctness, some investigations with platinum which will be found in their original paper.

Now a peculiarity is observed. It is noticed that the osmium is largely eliminated; the above analysis shows that more than half has been removed. It will also be noticed that, according to the same analysis, but 7·09 per cent are added in the way of phosphorus, yet in practice it is noticed that in fusion an *increase* in product is uniformly obtained of from 7 to 10 per cent in weight. According to the above analysis the loss of osmium and increase as phosphorus about counterbalance each other. How, then, can we account for the additional weight?

This is an interesting point for investigation. The increase in weight of 7 to 10 per cent with decrease of specific gravity show considerable increase of volume, which, in the case of such a valuable metal as iridium, is an item of considerable importance in its economy.

It may be observed that dephosphorisation has not been found necessary in any of the applications of the metal except for electricity.

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* See original article in *Am. Chem. Journ.*, vol. v., No. 4.

When dephosphorised the metal appears to be very slightly porous, but not to such an extent as to depreciate its value in any of the applications thus far made.

(To be continued.)

ABSOLUTE ALCOHOL.*

(Continued from page 10.)

By the first distillation the sp. gr. was only reduced by about a unit in the fourth decimal place. That is, the alcohol was about 0·79394 at the start, and was 0·79383 at the end, and the different fractions differed materially. The result not being as low as was occasionally seen on the large scale of manufacture with less precaution, the cause of this was to be sought for. On several occasions during the years 1882 and 1883 large quantities had been seen as low as 0·79364, 0·79369, 0·79375, &c.

The only discoverable difference was that on the large scale the liquid distilled was comparatively free from suspended lime, whilst in this distillation it was almost of the appearance of milk from suspended particles of lime.

From this circumstance a conclusion was reached, upon general chemical principles, that there must be a point at which the affinities of the alcohol and the lime for the water were balanced, and that this balance was constant only for a constant temperature. That when the two were left together, each having its share of the water for the lower temperature, and the temperature was then raised, a dissociation occurred, the alcohol taking back from the lime some of the water it had given up at the lower temperature, forming a new balance for the new temperature.

The same alcohol, with a sufficient addition from the original supply to make up the losses, was again subjected to the same treatment as before, only that after the shaking it was allowed 48 hours or more to settle. But, being as milky looking as before, it was filtered by aspiration with the pump through a large chloride of calcium jar filled with the caustic lime resting on a plug of glass wool. The filtrate was returned without contact with undried air until it came through very nearly clear, and was then drawn into the distilling flask until the charge was obtained; the filtration requiring about a week by reason of the nearly impervious stratum of very fine lime which formed in the filter.

This time the distillate came off at 0·79349 and 0·79350, and when the fractions, excepting the first and last, were mixed together, the sp. gr. was 0·79350. This distillation left an oily looking stain upon the distilling flask, which, with other circumstances, led to the conclusion that some impurity in the lime had been washed out by the alcohol, and that thus the distillate might be rendered less pure and clean than it should be.

The total distillate was therefore discarded, and a fresh supply taken having a sp. gr. at the start of 0·79387, and this was put through the same process, only that it several times nearly ceased to pass through the lime filter, and it became necessary as often to uncover the lime to break up the impervious crust, and thus expose the alcohol and the lime to the ordinary air of the room in damp weather. The distillation from this charge was, as anticipated, of high sp. gr., namely, 0·79365, or not much lower than at the start, but the alcohol was clean and good.

The same alcohol, with a portion from the original supply to make up losses, was put through the process, but the shaking was much diminished in time, so as to have less finely divided lime to obstruct the filtration, and less lime was used. Another and very much larger lime percolator was set up and charged with ground lime from which all the very fine particles had been sifted out. This percolator was of the capacity of about 5 litres, and held about 2 to 2·5 kilogrms. of the lime, and was fitted with an air-tight cover in which was a hole fitted with a rubber stopper with two tubes. Two 5 litre bottles were fitted with good stoppers, through which passed two tubes, one to the bottom of the bottle, and the other just through the stopper. The outer end of each tube was fitted with a short piece of rubber tubing and a pinch-cock. Both bottles having been filled with desiccated air, the long tube of one was connected to the lower end of the lime percolator in such a way as to be controlled by a pinch-cock, and so that the rate of dropping from the percolator could be seen and controlled. Then the milky alcohol from the shaker was drawn over from the bottle on to the lime percolator by a syphon controllable by a pinch-cock, and the air which entered the bottle as the alcohol ran off was supplied from the desiccator. The alcohol was passed through the percolator at the rate of about a drop a second, and was supplied on top at a similar rate; so that about twenty-four hours was required to pass a charge through the lime. When the bottle at the top of the percolator was empty, the one below it was two-thirds filled, and the lime was full of the alcohol, with a thin stratum above it. The pinch-cocks were then closed, the full bottle placed at the top of the percolator, and the empty one with dried air was put in its place below, and the apparatus started as at first. In this way the alcohol was passed through the lime twice with a much diminished exposure to undried air. The charge was then aspirated into the clean, dry distilling apparatus by means of the pump, and distilled in fractions as before. The result was that it all, excepting two small fractions, one at each end which were not weighed, came over at 0·79349 to 0·79353.

This alcohol, without the further addition of lime, and with the least practicable exposure to air, was passed through the lime percolator eight times, and then distilled. It then gave a sp. gr. of 0·79350. Weighed at 15° C. and compared with water at 4° C. as unity, the apparent sp. gr. was 0·79348. This, corrected for expansion of glass, gives a true sp. gr. of 0·7932618.

A new portion of lime was then slaked with the smallest quantity of water that would reduce it to a fine dry powder. This powder was then calcined at a red heat for about seven hours and, while still warm, 100 grms. of it was put into each of two bottles, carefully supplied with dried air. On to this lime about two litres of the alcohol of the last distillation was drawn through the lime percolator. The bottles were then put into the shaker and were shaken three times, at intervals of an hour or two, for about ten minutes each time. They were then allowed to settle for ten minutes each time. They were then allowed to settle for twenty-four hours, but still remained milky. The alcohol, as free as possible from the settled lime, was then passed four times through the same lime percolator as before, coming off entirely clear and bright after the second time. It was then aspirated into the distilling flask and distilled as before. The sp. gr. was, at 4° C., compared with water at 4° C., 0·80256. At 15·6° C., compared with water at 15·6° C., it was 0·79351.

This terminated the series of distillations, because it was concluded that the best results by the use of lime and the described management had been reached, and not because the alcohol had been entirely dehydrated.

That it was not entirely dehydrated was probable, from several considerations. First, both lime and alcohol form definite combinations with water, and at very low degrees of hydration it is highly probable, at least, that each will take water from the other until a balance of affinities be reached, so that both the lime and the alcohol form complex molecules of two, three, or more molecules of lime or alcohol to one of water, constant only when together, under constant conditions of temperature and pressure.

Many of the authorities on absolute alcohol state that in the distillation of the alcohol after dehydration, only the middle portions of the distillate are anhydrous. This statement is difficult to comprehend. It is impossible to understand how, in the distillation of alcohol which

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* From An "Ephemeris of Materia Medica, Pharmacy, Therapeutics, and Collateral Information," by E. R. Squibb, E. H. Squibb, and C. F. Squibb.

contains any water at all, the first and last portions should come over hydrated and the middle portion anhydrous. These distillations only appear to show this, while the truth must be that the middle portions are only a little less hydrated than the two end portions. No completely anhydrous alcohol will be reached until the distillate is of the same sp. gr. from beginning to end. The writer's experience has shown that the lower the sp. gr. the more uniform was the distillate throughout, but he never reached a point where if carefully weighed in the large bottle, there was not a slight difference between the ends and the middle of the large distillations of 4 litres at a time, requiring an entire day for the process. In his best results the difference was pushed back to the fifth decimal place, but it was always perceptible.

Again, it was not possible to manage the whole prolonged process and manipulations without some slight admissions of undried, or only partially dried air, and as the lower hydrations were reached it became very plain that so very strong was their affinity for moisture that very trifling admissions of undried air through a joint that would leak only a few small bubbles into the apparatus before discovery, would raise the sp. gr. perceptibly. Although such admissions were reduced to a minimum during the later distillations they were not altogether prevented, and their reduction was effected after the lime percolator had been so long used as to need a renewal of the lime. It seems quite certain, therefore, that undried air has a very important influence, and that it was not wholly excluded in any of the distillations, and also that toward the end the effectiveness of the lime percolator was diminished.

From all these circumstances it is safely concluded that anhydrous alcohol was not reached; and that if two or three weeks more could have been spared to the work, with a renewal of the lime, and the lime better calcined, slightly lower results might have been reached even by the use of lime. Furthermore, the weather had become warm, and the air loaded with moisture, a condition recognised for many years past, in actual experience on the large scale, as being very unfavourable to the management of the process for absolute alcohol. Clear, cold weather, with a high barometer and a low dew point, often makes a favourable difference of one or two-tenths of a per cent in the result of a large distillation, even before the loss of strength inevitable in bottling the distillate.

The alcohol which resulted from these distillations was critically examined, and seemed to have all the sensible and chemical properties of pure and unchanged alcohol, except that it did not entirely resist the reaction of nitrate of silver. By prolonged contact even in diffused daylight the nitrate was very slowly and continuously reduced, so that in three or four days a scanty black precipitate was visible, and this seemed to increase slowly as long as it was under observation. It is possible that the contact with the rubber tubing and stoppers in the distillation may have been the cause of this very slight reaction, but in every case it affected the tint of the alcohol within 8 or 10 hours. It seems almost certain that permanganate of potassium decomposes pure alcohol more rapidly as the strength increases beyond 97 or 98 per cent, and it is possible that nitrate of silver does the same.

The distillation in 23 inches of a vacuum insured the absence of ethers, &c., of low boiling-point, which might have been accidentally produced, and the most cultivated senses of professional experts in wine and spirits failed to detect any of the substances of higher boiling-points. The only test not applied to it was that of combustion, and this was not resorted to, because several observers in the past have verified their results by repeated combustions of their alcohol, when it is now known that such alcohol must have contained water. To make such combustions that would be entirely trustworthy is very difficult indeed, and the writer would be quite incompetent to such work where such extremely accurate weighings are required, with such a difficult substance, containing so very small a proportion of water only.

Nine distillations were made, of which the principal ones only are given, and over one hundred and twenty weighings, and many of them were very successful.

(To be continued.)

PROCEEDINGS OF SOCIETIES.

UNIVERSITY COLLEGE, LONDON,

Chemical and Physical Society.

Thursday, December 18, 1884.

C. E. Cassal, F.I.C., F.C.S., President, in the Chair.

Mr. J. T. Leon described the preparation of the double potassic chromic oxalate and distributed specimens of $K_2Cr_24C_2O_4.8OH_2$.

Mr. S. Rideal, B.Sc., then read a paper on "*The Chemistry and Physics of Hot Springs*" (*Part* 1. *The Physics*). After having drawn attention to some of the more recent theories on the internal heat of the earth and the distribution of underground temperature, the author described the chief forms of constant and intermittent hot springs, the localities in which they occur, and the conditions necessary for their existence. The periodic springs and geysers of the Yellowstone National Park were dwelt upon at some length, the author considering that Bunsen and Descloizeaux's theory for the production of the phenomena of the great geyser of Iceland was applicable to most of the geysers of the Yellowstone. The origin of the eruptive action appears to be situated in the hot part of the pipe, and not, as some have supposed, at some depth below. Geyser and volcanic action were compared from a physical point of view.

Samuel Rideal, *Hon. Sec.*

THE FRANKLIN INSTITUTE.*

Purification of Water.

The Secretary alluded to the experiments that were being conducted under the direction of Chief Engineer Ludlow, of the Water Department of Philadelphia, with the object of purifying the water supply by a system of artificial aëration. These experiments had proved very encouraging, and promised to yield important practical results. The plan employed, which is that suggested by Dr. Albert R. Leeds, differs from others that have been employed for a similar purpose. Laboratory experiments made by Dr. Leeds indicated that the advantageous action of atmospheric air in modifying and, in part, removing the impurities of water in contact with it, was greatly increased by producing the intermingling of the two fluids under pressure. The greater the pressure, the greater the absorption of oxygen, and consequently the greater the reduction of the impurities. The precise measure of this increase has not yet been ascertained. In order to try the experiment on a larger scale, and in such a manner as to afford some evidence of its value in practical operation, one of the Fairmount turbine engines (No. 8) was altered so as to convert it, in part, into an air-pump, by simple mechanical artifices unnecessary to describe. The result reached by the action of the pumps thus modified was the delivery of about 20 per cent by volume of free air into the water discharged into the main, this proportion being that which had been shown by experiments of Professor Leeds to be sufficient to surcharge the water.

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* Abstract of the Proceedings of the Meeting held Wednesday, December 17th, 1884.

By subsequent comparison of samples of water from the Fairmount pool taken into the pump, and of the water discharged into the Corinthian basin after passing through 3600 feet of main, the results of the experiment were made apparent. The percentage of oxygen in the aërated water was 17 per cent greater than before; that of carbonic acid was 53 per cent greater; and that of the total dissolved gases 16 per cent greater. The percentage of free ammonia was diminished to 1-5th of its former amount. The percentage of free oxygen represents the excess over and above what was required to effect the oxidisation of the organic impurities. These results are most favourable, and point clearly to the entire feasibility of reducing the percentage of organic matters contained in water unduly contaminated with sewage, within the limits of safety.

CORRESPONDENCE.

A LABORATORY ACCIDENT—A WARNING.

To the Editor of the Chemical News.

Sir,—On Nov. 24th a serious accident happened to me in the laboratory, some details of which will be of interest not only to my chemical friends at home but also to chemists generally.

In order to remove the stopper of a bottle containing phosphorus trichloride, I was very cautiously warming the neck over a small spirit-lamp, when the bottle burst to pieces with great violence. This can only be accounted for on the supposition that much hydrochloric acid had been formed in the bottle by the gradual entrance of moisture, so that the bottle was already under great pressure. The trichloride had done duty for many years as a specimen for the lecture table. Unfortunately I did not take into consideration the likelihood of this decomposition having taken place, and being short-sighted I was naturally looking very closely at the bottle at the moment of explosion. My right eye was deeply cut by the glass, cornea and iris being extensively wounded, and of course the aqueous humour discharged. The hæmorrhage from the iris which followed has prevented the attempts to explore the eye with the ophalmoscope, so that the full extent of the injury cannot as yet be actually ascertained. There is reason to hope that no glass remains in the eye, but this is uncertain. Strange to say the infliction of the wound caused not the slightest pain, and inflammation has as yet been kept down. Vision is for the present lost to the wounded eye, but will, it is hoped, be regained. I have the benefit of the attendance of Mr. Scriba, a skilful German ophthalmic surgeon, and of Dr. Macdonald, a Canadian physician, so that my friends need not fear that I am without efficient medical advice.—I am, &c.

Edward Divers.

Imperial College of Engineering, Tokio,
Nov. 29, 1884.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

Note.—All degrees of temperature are Centigrade unless otherwise expressed.

Comptes Rendus Hebdomadaires des Séances, de l'Académie des Sciences. Vol. xcix., No. 24, December 15, 1884.

On the Determination of a Particular Case of Isomerism among the Acetones.—G. Chancel.—The organic compounds known as ketones form two principal classes. The ketones, properly so-called, of which acetone is the type, result from the dry distillation of the calcium or barium salts derived from a single acid. As they contain twice one and the same alkylic radicle united to a carbonyl, the author proposes to call them equi-ketones. The others, which contain two different alkylic radicles are the mixed ketones. They are formed in various reactions, and are easily obtained by distilling mixtures of the salts of two acids. All these bodies present, especially in the higher terms of the series, numerous isomerisms. Their constitution may be generally fixed by determining the nature of the two acids which result from their oxidation. M. Popoff has demonstrated that any equi-ketone gives, on oxidation, two acids, the acid which produces the ketone and an acid of a lower scale. Under the same circumstances a mixed ketone is split up, giving its carbonyl to the lowest alkylic radicle. Where this method of determination is impracticable, the ketones are submitted to the action of nitric acid, which transforms them into alkyl-nitrous acids; the properties and the composition of potassium and silver alkyl-nitrites remove all doubt. Thus propione gives ethyl-nitrous acid, the potassium salt of which, of a fine yellow, is turned red on exposure to the sun, and resumes its original colour in darkness. One part of this salt dissolves in 29·1 parts of water at 0°, and in 19·4 of water at 12°. It contains 24·68 per cent of K, whilst the silver salt contains 47·58 per cent Ag. Methyl-propyl-ketone yields propyl-nitrous acid. The colour of the potassium salt is not altered by light. One part of this salt dissolves in 33·4 parts of water at 0°, and in 23·2 parts at 12°. It contains 22·67 per cent K, whilst the silver salt contains 44·81 per cent Ag.

On Certain Procedures in Practical Spectroscopy.—M. Eug. Demarçay.—The spark of the bobbin previously described is arrested even by a thin layer of a conductive solution. We may easily obtain its spectrum by using a small metallic wick formed of platinum wire of 0·15 m.m. in thickness. Of this wire 8 strands are twisted together. This band is then coiled in a circle of 5 to 6 m.m. in diameter, and the end is bent perpendicularly to the plane of the circle so as to overtop the level of the liquid by at most 3 to 4 m.m. This nick is then placed in a small platinum spoon which receives the liquid under examination (a drop is sufficient), so that its extremity is visible above the edge. Or it may be placed in a tube analogous to those of M. Lecoq, taking care that the circle of the wick touches the wire which traverses the bottom of the tube. Between the end of this wick and a stout platinum wire which serves as a positive electrode the spark is made to pass. It should not be longer than 0·50 to 0·25 m.m., and may be still shorter without inconvenience. The solutions ought not to be very concentrated, otherwise there is soon formed at the end of the wire a clot of solid matter which masks the spark. The wicks ought to be very carefully cleansed with weak aqua-regia, or hydrofluoric acid, or fusion with a bisulphate as the case may be. The nature of the solvent is not a matter of indifference. The solution ought to be stable. Hydrofluoric acid should be employed for the detection of niobium, tantalum, silicon, and tungsten. Its presence does not interfere with the production of other spectra, and it even gives lustre to certain of them, such as the alkaline metals. The spectra of all the simple bodies are thus obtained without difficulty, even the most refractory (iridium, tantalum, uranium, osmium, &c.). These are in general spectra, with fine lines, of which the violet part especially is extremely bright. A spectrum of bands nevertheless appears if the metallic solution gives one, but the fine lines always predominate. Certain non-metals (arsenic, tellurium, selenium) yield their spectra with difficulty. In this case the spectrum of the solvent and that of the electrodes appear, which are ordinarily absent. The sulphuric, selenic, phosphoric, and arsenic acid give the line-spectra of sulphur, selenium, &c. But a very slight quantity of metal in solution suffices to make them disappear. The acids of the halogens give rise to the same observations. Nitric acid gives, very feebly, the secondary spectrum of nitrogen, but a trace of metal suffices to make it vanish. The spectrum of hydrogen is represented by the two red and blue rays, which are very distinct, narrow, and do not interfere. The alkaline solutions of the metallic acids give simultaneously the spectra of the two metals. All these spectra approach closely those of the electric arc, as appears from examining those of sodium and potassium. They are, in fact, identical with the spectra which Liveing and Dewar have obtained in this manner.

Attractions exerted between Bodies in Solution and Solids in Suspension.—J. Thoulet.—The author proves experimentally that if a salt is dissolved in a liquid, and if a solid body is immersed in the solution, there is produced between these two bodies an attraction independent of all chemical action. By this attraction are explained the following phenomena:—The impurity of most chemical precipitates, especially of those which are gelatinous. The reduction of the strength of saline solutions decolourised with bone-black; the *modus operandi* of colloidal bodies (blood, albumen. &c.) employed in the clarification of liquids. Purification of surface waters as they become spring waters; clarification of sewage and liquid manure by passing through the soil. The clays which remain indefinitely suspended in distilled water are rapidly precipitated in waters containing salts in solution (sediments deposited at the mouth of rivers).

The Dissociation of Chloral Hydrate.—H. Le Chatelier.—This paper is not adapted for useful abridgment.

A Contribution to the Study of Brucine.—M. Oechsner de Coninck.—Like cinchonine, brucine contains in its molecule a quinoleic tetrahydride. This confirms the hypothesis of Wirchnegradsky, according to which the pyridic and quinoleic bases exist as hydrides in the fixed alkaloids.

Justus Liebig's Annalen der Chemie,
Vol. 226, Part 2.

The Combustion of Hydrocarbons, their Oxides, and Chlorides, with Chlorine and Oxygen.—G. Schlegel.—The author's results are summarised as follows:—If a hydrocarbon which is attacked by chlorine only in the light is mixed in the dark with an excess of chlorine and of oxygen, and the mixture is ignited by the spark, all the carbon burns to carbon dioxide and all the hydrogen to hydrochloric acid. No chlorine combines with carbon and no oxygen with hydrogen. If there is an excess of oxygen, whilst the chlorine does not suffice to convert all the hydrogen into hydrochloric acid, the residue of the hydrogen burns to water. If the chlorine is in excess whilst the oxygen does not suffice to convert all the carbon into carbon dioxide, there is formed simultaneously carbon monoxide, in a larger proportion the less oxygen is present. There is generally formed rather more carbon dioxide than could be produced by an equal distribution of the oxygen, so that the latter does not appear in its totality among the products of combustion. What becomes of this missing fraction the author has not ascertained. It seems to remain combined with hydrogen, or perhaps also with chlorine, for in general there is less chlorine burnt than would suffice for the whole of the hydrogen. If neither chlorine nor oxygen is sufficient, carbon is separated out, and the combustion remains imperfect. The behaviour of the chlorides and oxides of the hydrocarbons is similar.

On Chrysaniline.—O. Fischer and G. Koerner.—The author describes the preparation of chrysaniline in a state of purity, its behaviour with hydrochloric acid, the source of phenyl-acridine, the origin of chrysaniline in the magenta melt, and a new synthesis of chrysaniline.

Communications from the Chemical Laboratory of the University of Jena.—These consist of a paper of Dr. J. W. James on acetacetic ether, a memoir by A. Geuther on certain derivatives of symmetric iso-dichlorethyl ether, and a paper by the same author on the action of lead hydroxide and silver oxide upon the aqueous solution of sodium pentasulphide and sodium dithionite.

On Uric Acid from Fumaric Acid and the Calcium Salts of the Four Isomeric Tartaric Acids.—R. Anschütz.—Not adapted for useful abstraction.

Synthesis of Homoquinine.—O. Hesse.—If cupreine and quinine are dissolved in an excess of dilute sulphuric acid, the solution is precipitated with ammonia, and the precipitate shaken up with ether, the ethereal solution yields crystals of pure homoquinine.

On Ethylen-amido-benzoic Acids.—H. Schiff and C. Parenti.—This paper does not admit of useful abstraction.

Journal de Pharmacie et de Chemie.
Series 5, Vol. x., December, 1884.

Experimental Studies on the Preservation of Chloroform.—Jules Regnauld.—Among the destructive agents are mentioned light, and the electric effluve in presence of oxygen. On the other hand, the alcohols have a preservative action. Benzol is almost ineffective, whilst toluol is probably more effectual than alcohol.

Researches on Vegetation: Studies on the Formation of the Nitrates.—MM. Berthelot and G. André.—From the *Comptes Rendus.*

Solubility of Mercuric Iodide in Water.—E. Bourgoin.—At ordinary temperatures a litre of water dissolves about four centigrammes of mercuric iodide. The quantity dissolved increases with the temperature, and is also augmented by the addition of alcohol.

On Phosphorus Trifluoride.—H. Moisson.—Phosphorus trifluoride is not, as is commonly stated, a liquid boiling at 60°, but a gas which is not liquefied at 24° under a pressure of 180 atmospheres. At −10° and under a pressure of 40 atmospheres it remains as a colourless, very mobile liquid, which has no action upon glass.

A Trichloro-Camphor.—P. Cazeneuve.—From the *Comptes Rendus.*

The Assimilation of Maltose.—MM. Dastre and Bourquelot.—The author arranges the sugars as regards their utilisation by the animal economy in the following order, beginning with the most refractory: saccharose, lactose, maltose, and glucose.

New Process for Manufacturing Potassium Dichromate.—M. Roemer.—The author melts 100 parts of chrome ore with a flux composed of 150 parts lime, caustic potassa 40, and caustic soda 30. The melt when cold is lixiviated, and the solution obtained gives on treatment with sulphuric acid a mixture of potassium dichromate and sodium sulphate.

Detection of Morphine in the Urine of Opium-Eaters.—MM. Notta and Lugan.—(See p. 10).

Zeitschrift für Analytische Chemie.
Vol. xxiii., Part 4, 1884.

Calorimetric Determination of the Value of Fuel.—Franz Schwackhöfer.—For this voluminous and illustrated memoir we must refer to the original.

Determinations of the Fat of Milk.—Leo Liebermann.—This paper requires the two accompanying illustrations. The author's conclusion is that when rapid and accurate determinations of the fat of milk are required without the use of the balance, either the aræometric method of Soxhlet or the volumetric method must be used.

The Quantitative Determination of Reverted Phosphoric Acid and of Phosphoric Acid in Dicalcium Phosphate.—Carl Mohr.—After criticising Petermann's defence of the method of precipitating the phosphoric acid soluble in ammonium citrate, the author gives the following process:—A certain quantity, generally 5 grms., is treated with hot water in a mortar, and filtered into a measuring flask holding 200 or 250 c.c. After being three times covered with hot water, the insoluble part from the filter and the mortar is mixed in a small flask, and digested for an hour at 60° to 70° with 25 c.c. of an alkaline solution of ammonium citrate. After this digestion the alkaline solution is filtered into the aqueous one, the residue washed, and the flask filled up to the mark. If the liquid is not acid it is slightly acidified with nitric acid. 10 or 20 c.c. of this solution are mixed with an equal volume of fuming nitric acid, molybdic solution is added in plenty, and the mixture is digested for an hour on the sand-bath at 85°. When cold it is filtered. The yellow residue is dissolved in ammonia, filtered again, and is precipitated with magnesia mixture. The precipitate is either weighed or titrated with uranium, observing the precautions given by the author (*Zeit. Anal. Chem.*, xxi., 216). The precipitation with molybdenum is complete, but if too large an excess of the reagent is used it also is precipitated in part and adheres to the sides of the glass. If the experiment is then repeated with a smaller proportion of molybdenum a pure yellow precipitate is obtained.

Precipitation of Manganese with Bromine.—Carl Holthof.—This paper will be inserted at length.

A Simple Salt for Opening-up Silicates.—Carl Holthof.—(See p. 18).

A Contribution to the Chemical Examination of Ground Pepper.—W. Lenz.—The author has found, by experiment, that the determination of the alcoholic or the ethereal extract is worthless. Petroleum ether is also unsuitable. He proposes a method based on the circumstance that pepper is distinguished from the usual adulterants by its high percentage of starch. He proceeds, therefore, as follows:—3—4 grms. of the sample are allowed to stand for 3 to 4 hours in a boiling flask with ¼ litre distilled water, shaking frequently. The mixture is then filtered, washed with a little water, and the moist pepper is returned to the flask. Water is added to make up 200 c.c., and 20 c.c. hydrochloric acid at 25 per cent. The flask is closed with a cork fitted with an ascending tube 1 metre in length, and heated for 3 hours in a water-bath, which must boil briskly, shaking the flask frequently. When quite cold, it is filtered into a 500 c.c. flask, washed with cold water, the filtrate neutralised as exactly as possible with soda-lye, and the flask filled up to the mark. The reductive value of this liquid is tested against 10 c.c. of Fehling's solution, diluted with 40 c.c. of water. In calculating the reduced sugar, it is assumed that 10 c.c. of Fehling's solution correspond to 0·05 grm. of sugar. If palm-kernels are present, the hot liquid clears up so imperfectly that a few drops of dilute zinc chloride must be added. As a final reaction, the author uses the disappearance of the red colour produced by potassium ferrocyanide in a drop of the filtrate, acidulated with acetic acid. Starchy impurities are readily detected microscopically.

Analysis of Pure Saar Wines.—W. Klinkenberg.—The author finds the samples examined absolutely pure.

A Substitute for the Calcium Chloride Tube in Ultimate Analysis.—Sigismund Schmitz.

Funnel for Filtration with Exclusion of Air or in a Current of any Gas.—F. Allihn.—These two papers cannot be intelligibly reproduced without the accompanying figures.

The Solubility of Glass.—E. Bohlig.—The author received a number of flasks, burettes, &c., of such a composition that distilled water boiled in them, required for neutralisation, the addition of 1-10th c.c. of decinormal oxalic acid every two, *ad infinitum*. Professor Fresenius, to whom two of the flasks were sent, confirms this statement.

Spectral Analysis.—F. Lippich obtains very luminous spectra by substituting for the prisms a reflexion grating and a concave mirror for the object glass of the telescope.—F. Lommel, for the study of the phenomena of phosphorescence and of the ultra-red rays of the spectrum, introduced in that part of an ordinary spectral apparatus where the thread cross is commonly fixed a thin glass covered with Balmain's luminous paint, so that the spectrum is visible through the stratum of this substance.—C. Auer Von Weisbach, for examining the earths of gadolinite, introduces an essential modification in the production of spark spectra, and in this manner obtains results which were formerly impracticable.

The Oxidation of Mercury in the Air.—D. Macaluso.—Dry pure air has no action on pure mercury. Watery vapour, when alone, has no action, but moist air effects oxidation.

Determination of Vapour Densities.—A notice of the modifications in the apparatus of Victor Meyer, introduced by H. Schwarz, and used in determining the vapour density of glucinum chloride by Nilson and Petterson.

On Thermometers.—J. M. Crafts.—From the *Comptes Rendus*.

Covering for Evaporating-Capsules.—V. Meyer.—This short memoir requires the accompanying illustration.

Improved Gas-Burners.—The Editor mentions the names of several inventors in this department, without giving any details.

A Check-Observation Tube for Polarising Instruments.—F. Schmidt and M. Hänsch.—The check tube admits of a change in the length of the stratum observed, so that with one solution applied in various lengths different parts of the scale can be verified.

A Bath for Constant Low Temperatures.—W. W. J. Nicol.—From the *Phil. Mag.*

Apparatus for Determining the Melting-points of Fats.—H. Krüss.—A modification of the apparatus of J. Löwe.

The Development of Gases.—J. R. Duggan.—From the *Amer. Chem. Journ.*

The Alkaline Reaction of Glass.—U. Kreussler and O. Henzold.—The Editor, commenting on the experiments of the authors, declares that the glass commonly used in our laboratories is attacked by boiling water and watery vapours to a very high—it might even be said to an alarming—extent.

Purification of Ammonium Fluoride.—P. T. Austen and F. Wilber.—From the *American Chemical Journal.*

A New Method for the Qualitative Separation of Tin, Antimony, and Arsenic.—E. Berglund.—This paper will be inserted *in extenso*.

Separation of Molybdenum and Vanadium.—Wolcott Gibbs.

Separation of Vanadium and Tungsten.—Wolcott Gibbs.—These two papers are taken from the *American Chemical Journal.*

The Determination of Nitric Acid.—R. Warington.—From the *Journal of the Chemical Society.*

A New Reaction of Benzidine.—Paul Julius.—An aqueous solution of benzidine on the addition of a solution of potassium dichromate gives immediately a very bulky, deep blue precipitate, consisting of felted needles, and insoluble in all ordinary solvents. This precipitate, benzidine chromate, may be obtained if only 1 part of benzidine is present in 50,000 of water.

Determination of Moisture in Flour.—M. Bondonneau.—The author mixes 5 to 10 grms. of the sample with an equal weight of water, stirs it up with the addition of a few drops of ammonia, and evaporates in a flat capsule, in a thin stratum, at a temperature below 40°. When no further loss takes place the temperature is gradually raised, reaching 60° in three hours and 100° in an additional hour.

MISCELLANEOUS.

Royal Institution.—Professor H. N. Moseley will, on Tuesday next (Jan. 13), begin a course of five lectures on "Colonial Animals, their Structure and Life Histories;" Professor Dewar will on Thursday (Jan. 15) begin a course of eleven lectures on "The New Chemistry;" and Dr. Waldstein will on Saturday (Jan. 17) begin a course of three lectures on "Greek Sculpture, from Pheidias to the Roman Era." The Friday Evening Meetings will begin on Jan. 16, when Professor Tyndall will give a Discourse on Living Contagion.

Artesian Water Supply.—Messrs. Howards and Sons, Chemical Manufacturers, of Stratford, have just established an independent water supply of over 40,000 gallons per day, to meet the requirements of their works. This has been obtained for them by Messrs. Le Grand and Sutcliffe, of London, who have sunk one of their artesian tube wells 250 feet deep. An unusually varied number of strata (interesting from a geological point of view) was passed through before reaching the chalk, from whence the supply is drawn, which was met with at 132 feet below the surface. It is calculated that an economy of between £300 and £400 per annum will thus be effected in water rates alone, while a still further advantage and saving is derived from the fact that the water so obtained is remarkably pure and of uniform quality and temperature, enabling it to be used in its natural state for many purposes for which the water company's supply could only be employed after distillation.

Society of Arts.—The ordinary Wednesday evening meetings of the Society of Arts will re-commence, after the Christmas recess, on January 14, when Mr. R. H. Tweddell will read a paper on "The Employment of Hydraulic Machinery in Engineering Workshops." The following are the papers arranged for subsequent evenings:—January 21st, "Labour and Wages in the United States," by D. Pidgeon. (On this occasion the Hon. J. Russell Lowell, the American Minister, will take the chair.) January 28th, "The Influence of Civilisation upon Eyesight, by R. Brudenell Carter, F.R.C.S. "The History and Manufacture of Playing Cards," by George Clulow; "The Musical Scales of Various Nations," by A. J. Ellis, F.R.S.; "A Marine Laboratory as a means of Improving Sea Fisheries," by Prof. E. Ray Lankester, F.R.S.; "Recent Improvements in Coast Signals," by Sir J. N. Douglass; "The Evolution of Machines," by Prof. H. S. Hele Shaw; "Education in Industrial Art," by Charles E. Leland; "The American Oil and Gas Fields," by Prof. James Dewar, F.R.S.; "Past and Present Methods of Supplying Steam Boilers with Water," by W. D. Scott Moncrieff.

MEETINGS FOR THE WEEK

Monday, 12th.—London Institution, 5.
— Medical, 8.30.
— Society of Arts, 8 (Cantor Lectures.) "Climate, and its Relation to Health," by G. V. Poore, M.D.
Tuesday, 13th.—Royal Institution, 3. "Colonial Animals," by Prof. Moseley.
— Royal Medical and Chirurgical, 8.30.
— Institution of Civil Engineers, 8.
Wednesday, 14th.—Society of Arts. 8. "The Employment of Hydraulic Machinery in Engineering Workshops," by Ralph H. Tweddell, M.Inst.C.E.
— Microscopical, 8.
Thursday, 15th.—London Institution, 5 and 7.
— Royal, 4.30.
— Philosophical Club, 6.30.
— Royal Institution, 3. "The New Chemistry," by Prof. Dewar.
— Chemical Society, 8. "On the Atomic Weight of Titanium," by Professor T. E. Thorp, F.R.S. (1) "Note on the Constitution of Propylene Chlorhydrol;" (2) "On the Action of Zinc Chloride on the Benzoate from Propylene Chlorhydrol," by Dr. F. Morley and Mr A. G. Greene. "On Nitro-benzal-malonic Acid," Mr. Stuart.
Friday, 16th.—Royal Institution, 8. "Living Contagia," by Professor Tyndall, at 9.
Saturday, 3rd.—Royal Institution, 3. "Greek Sculpture," by Dr. Waldstein.

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THE CHEMICAL NEWS.

Vol. LI. No. 1312.

THE NEW "RIVERS' POLLUTION" BILL.

Sanitarians must naturally feel unpleasantly surprised at finding that a new Bill for improving the condition of our rivers should be introduced before the Act of 1876 has been fairly put in force. The thought lies near at hand that whatever conditions and circumstances have rendered the old Act to no small extent a dead letter will also tell against the proposed measure, should it become law.

The public astonishment will assuredly not be lessened when it appears that the new Bill embodies the much discussed "recommendations" of the late Royal Rivers' Pollution Commission. We certainly hoped that we should not again have been compelled to discuss these most unpractical standards. Their shortcomings and inconsistencies have been so often laid bare, and any rational justification of their character has been so completely wanting, that we hoped even the "recommenders" themselves would have been glad to consign them to forgetfulness. We were, it seems, mistaken, and we must again resume the task of proving propositions almost self-evident.

The first error of the persons whose mouthpiece Mr. Hastings, Earl Percy, and Colonel Walrond have apparently made themselves, is the attempt to fix one uniform standard for all rivers, whatever may be the character of the regions through which they flow. Even a little common sense should enable any man to see that a scale rigorous enough for the Irwell, the Sankey, the Aire, or the Clyde, is far too lax for the Leven, the Dudden, or the Derwent. Hence we have contended that the river itself should be made the standard of purity, and that nothing should be allowed to enter which should be found more polluted than the river itself. This plain proposal would entirely prevent the introduction of nuisances into certain districts; it would cut off an evasion to which the "recommendations" are open, and it would furnish a standard of purity which must become higher from year to year.

The second capital flaw in the "recommendations" is that whilst laying down a limit in *quality*, they say nothing about *quantity*. This opens the gate wide for an easy evasion. Let us suppose that Messrs. Nokes are the proprietors of a large dye-works, tannery, or the like, on the banks of a river. They find that their waste waters contain more than the 2 parts by weight of "organic carbon" per hundred thousand, and that they are consequently open to the pains and penalties provided. This does not alarm them; they simply pump up from the river, or admit from any brook or well available, so much clean water as may be needed to dilute their refuse liquids down to 1½ or 1 part of organic carbon per hundred thousand. This stratagem need not be employed ostensibly for evading the law. A manufacturer can surely find occasion for washing out tanks, vats, channels, casks, carboys, floors of buildings, &c., and who is to interfere, or to fix the quantity of water he may use?

It is further evident that the purer the river, and consequently the greater the importance of preserving it pure, the easier such evasion will become. Now we trust that even the inspirers of this Bill will not be able to shut their eyes to the fact that whether we pour into a river daily 100,000 gallons of water containing 2 parts of "organic carbon," or 200,000 gallons containing half that proportion, the total proportion of pollution conveyed into the river remains the same.

If, instead of this futile "recommendation," we make the river the standard of purity, such evasions are excluded, since, however we may dilute sewage or industrial waste liquors with the water of any given river, the resulting mixture must always be more polluted than was the river-water previously.

The first of the proposed standards of purity refers merely to suspended matter, mineral or organic.

The second inhibits, in the well-known words "any liquid containing in solution more than 2 parts by weight of organic carbon or 0·3 part by weight of organic nitrogen in one hundred thousand parts by weight." It has been asked, and asked in vain, how did the "recommenders" know that "organic carbon" and "organic nitrogen" were respectively admissible up to these limits, but perilous beyond? It has been pointed out that both organic carbon and organic nitrogen vary indefinitely in their septic and pathogenous powers, according to the combination in which they are involved. But to all such considerations the inspirers of the Bill are blind. Be the carbon and nitrogen in question components of matter, putrescent or non-putrescent, of antiseptics, or of cholera bacilli, all is one!

The fourth standard forbids "any liquid which contains in solution in one hundred thousand parts by weight more than two parts by weight of any metal except calcium, magnesium, potassium, and sodium." All others, with the single exception of arsenic, for which special provision is made under the next head, are treated as exactly alike. This arrangement certainly appears grossly inconsistent if we reflect that, on the one hand, aluminium and iron are harmless in any proportion likely to find its way into rivers, whilst, on the other hand, chromium—which is now plentifully used in the arts—is little less dangerous than arsenic itself.

But we may ask why *carte blanche* should be given to calcium, magnesium, and sodium? Sodium sulphate, finding its way accidentally into a stream, has been known to make havoc among fish. Magnesium sulphate is a most objectionable ingredient in potable waters, and has been found injurious to horses. As for calcium sulphate, its solution in contact with river and pond-mud is well known as a source of sulphuretted hydrogen. We submit, therefore, that the introduction into any river of magnesium and calcium salts, in proportions greater than naturally occurs in the wells or streams of the district, ought not to be tolerated. Here, again, the river itself would furnish the only safe standard of purity.

Taking all these facts into full and candid consideration we can do no other than pronounce the Bill before us a mistake, which manufacturers and sanitarians should alike oppose.

RESEARCHES ON LIQUEFIED GASES.*

By Professor JAMES DEWAR, M.A., F.R.S.

The two Russian chemists, MM. Wroblewski and Olzewski, who have recently made such a splendid success in the production and maintenance of low temperature, have used in their researehes an enlarged form of the well-known Cailletet apparatus: but for the purposes of lecture demonstration, which necessarily involves the projection on a screen of the actions taking place, the apparatus represented in the annexed woodcut is more readily and quickly handled, and enables comparatively large quantities of liquid oxygen to be produced. The arrangements will be at once understood on looking at the figure, which is taken from a photograph. The oxygen- or air-reservoir, c, is made of iron; it contains gas compressed for convenience to 150 atmospheres. A is the stopcock for regulating the pressure of the gas in the glass tube, F, and D is the pressure-manometer, the fine copper tube which connects the gas reservoir and the glass tube, F, being shown at I. The air-pump guage is marked J, the

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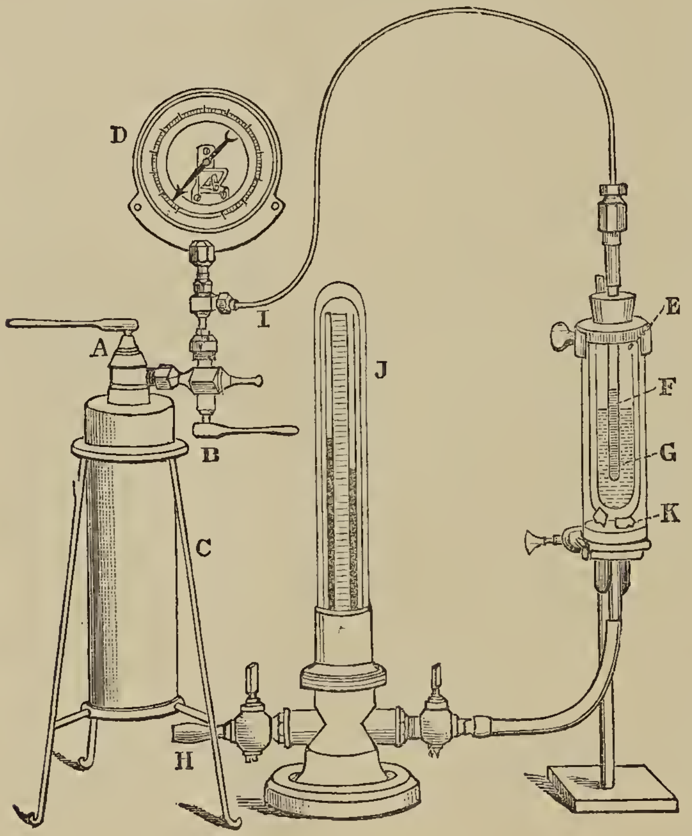
* A Paper read at the Royal Institution of Great Britain.

tube leading to the double oscillating Bianchi being attached at H. The glass test-tube, G, which contains the liquid ethylene, solid carbonic acid, or liquid nitrous oxide, which is to be boiled *in vacuo*, is placed in the middle of a larger tube. It has holes, shown at E, in the upper part, so that the cool vapours in their course to the air-pump are forced to pass round the outside of the vessel and help to guard it from external radiation. The lower part of the outer cylinder is covered with pieces of chloride of calcium, shown at K. If a thermometer is used and a continuous supply of ethylene maintained, the india-rubber cork through which the the tube F passes has two additional apertures for the purpose of inserting the respective tubes. When the pump has reduced the pressure to 25 m.m., the ethylene has a temperature of about −140° C.; a pressure of between twenty and thirty atmospheres is then sufficient to produce liquid oxygen in the tube F. The tube F is 5 m.m. in diameter, and about 3 m.m. thick in the walls, and when filled with fluid oxygen (for projection) holds at least 1·5 c.c. With such a quantity of fluid oxygen it is easy to show its ebullition at ordinary pressures, and by means of a thermo-junction to demonstrate the great reduction of temperature which is attendant on its change of state at atmospheric pressure.



Provided a supply of liquid ethylene can be had, there is no difficulty in repeating all the experiments of the Russian observers; but as this gas is troublesome to make in quantity, and cannot be bought like carbonic acid or nitrous oxide, such experiments necessitate a considerable sacrifice of time. It was, therefore, with considerable satisfaction that I observed the production of liquid oxygen by the use of solid carbonic acid, or preferably liquid nitrous oxide. When these substances are employed and the pressure is reduced to about 25 m.m., the temperature of −115° C. may be taken as that of the carbonic acid, and −125° C. as that of the nitrous oxide. As the critical point of oxygen, according to the Russian observers, is about −113° C., both these cooling agents may be said to lower the temperature sufficiently to produce liquid oxygen, provided a pressure of the gas above the critical pressure, which is 50 atmospheres, is at command. In any case, however, the temperature is near that of the critical point; and as it is difficult to maintain the pressure below about an inch of mercury, the temperature is apt to be rather above the respective temperatures of −115° C. and −125° C. In order to get liquefaction conveniently with either of these agents, it is necessary to work at a pressure of oxygen gas from 80 to 100 atmospheres, and to have the means of producing a sudden expansion when the compressed gas is cooled to the above-mentioned temperatures. This is brought about by the use of an additional stop-cock, represented in the figure at B. During the expansion the stop-cock at A is closed and the pressure manometer carefully observed. No doubt liquid nitrous oxide is the most convenient substance to use as a cooling agent; but as it is apt to get superheated during the reduction of pressure and boil over with explosive bursts of vapour, it is well to collect the fluid in a small flask of about 250 c.c. capacity, and to change it into the solid state by connecting the flask with the air-pump, and then to use the substance in this form. The addition of alcohol or ether to the solid nitrous oxide makes the body more transparent, and thereby favours the observations.

It is evident that this apparatus enables the observer to determine the density of the fluid gases condensed in the tube, F; since he has only to measure the volume of fluid in F, and to collect, by means of the stop-cock, B, the whole volume of gas given by the fluid and condensed vapour, which gives an accurate determination of the total weight of substance distributed between fluid and vapour in the whole apparatus. The amount of substance which is required to produce the vapour is easily found by observing the vapour-pressure of the liquid gas before expanding it into gas for the volume measurement; and while keeping shut the stop-cock, B, by opening A suddenly until this pressure is just reached, and then instantly shutting off the receiver. If this volume of gas is now measured by opening B as before, the difference between the two volumes thus collected will correspond to the real weight of substance in the liquid state. A rough experiment with oxygen near the critical point gave the density 0·65.

As to the most convenient substance for use as a cooling agent, I am still of opinion that marsh-gas would be the best; and I may take the opportunity of pointing out that the employment of this body was suggested by me in a communication made to the Chemical Section of the British Association in 1883. The following extract from *Nature* of October 4, 1883, will prove that my experiments with liquid marsh-gas were made a year in advance of those made recently by M. Cailletet* and M. Wroblewski †:—

"Professor Dewar pointed out an important relation between the critical temperatures and pressures of volatile liquids and their molecular volumes. The ratio of the critical temperature to the critical pressure is proportional to the molecular volume, so that the determination of the critical temperature and pressure of a substance gives us a perfectly independent measure of the molecular volumes. Prof. Dewar pointed out the great advantage of employing a liquid of low critical temperature and pressure, such as liquid marsh-gas, for producing exceedingly low temperature. He hoped to be able to approach the absolute zero by the evaporation of liquefied marsh-gas, whose critical temperature was less than −100° C., and whose critical pressure was only 39 atmospheres."

I ought to mention that the marsh-gas used in my experiments was made by the action of water on zinc methyl, and was therefore very pure, and that the observed critical pressure was not 39 atmospheres, but 47·6. The following table gives the values of the ratio of the absolute critical temperature to the critical pressure in the case of a number of substances. The values for ammonia, sulphuretted hydrogen, cyanogen, marsh-gas, and hydride of ethyl are new.

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* "Sur l'emploi du Formène pour la production des très basses températures," *Comptes Rendus*, June 30, 1884.

† "Sur les propriétés du gaz des marais liquide, et sur son emploi comme réfrigérant," *Comptes Rendus*, July 21, 1884.

		T. Critical temperature.	P. Critical pressure.	$\frac{T}{P}$
Chlorine	Cl_2	141·0°	83 9	5·0
Hydrochloric acid	HCl	52·3	86·0	3·7
Oxygen	O_2	−113·0	50·0	3·2
Water	H_2O	370·0	195·5	3·3
Nitrogen	N_2	−146·0	35·0	3·6
Hydrogen sulphide	H_2S	100·2	92·0	4·0
Ammonia	H_3N	130·0	115·0	3·5
Diethylamine	$(C_2H_5)_2HN$	220·0	38·7	15·4
Nitrous oxide ..	N_2O	35·4	75·0	4·1
Sulphurous acid..	SO_2	155·4	78·9	5·4
Marsh-gas	CH_4	−99·5	50·0	3·5
Acetylene	C_2H_2	37·0	68·0	4·5
Ethylene	C_2H_4	10·1	51·0	5·5
Ethyl hydride ..	C_2H_6	35·0	45·2	6·8
Amylene	C_5H_{10}	191·6	33·9	13·7
Benzol	C_6H_6	291·7	60·4	9·3
Chloroform.. ..	$CHCl_3$	268·0	54·9	9·9
Carbon chloride..	CCl_4	282·0	57 6	9·6
Carbonic acid ..	CO_2	31·9	77·0	4·0
Bisulphide of carbon	CS_2	277 7	78·1	7·0
Cyanogen	C_2N_2	124·0	61·7	6·4

A glance at the last column of the table shows that a large number of substances have at their respective critical temperatures simple volume relations. Thus hydrochloric acid, water, ammonia, and marsh-gas, the four chemical substances from which the great majority of chemical compounds may be derived by processes of substitution, have nearly the same volume; while the more complex derivatives show an increased volume which bears a simple ratio to that of the typical body. As the critical pressures are not known with any great accuracy at present, it would be useless to discuss the results with any severity. All that can be inferred is that the subject is worthy of further investigation and promises important generalisation. Sarrau (*Compt. Rend.*, 1882) deduced the critical temperatures and pressures of hydrogen, oxygen, and nitrogen by the application of Clausius's formula to the experiments of Amagat; and it is interesting to compare his results with the experimental values.—

Sarrau's Calculated Values.

	T. Critical temperature.	P. Critical pressure.	$\frac{T}{P}$
Hydrogen	−174°	98 9	1·0
Oxygen	−105·4	48·7	3·4
Nitrogen	−124	42·1	3·5

It will be observed that the calculated critical temperatures of oxygen and nitrogen are remarkably near the truth, being respectively 8° and 22° too high. On the other hand, the values of the ratios of the calculated critical temperatures and pressures are almost identical with those obtained by direct experiment. The only peculiarity to be noted is in the case of hydrogen, which has such a high critical pressure and therefore leads to a remarkably small molecular volume at the critical point. If the values of the T ÷ P ratio be taken as proportional to the molecular volumes, then it is easy to infer the densities of the fluids at their respective critical temperatures, provided the density of one standard substance is known by experiment. The simple formula thus stated is—

$$\frac{S'}{S} = \psi \frac{W'}{W} \psi = \frac{V}{W}$$

where S and S′ are the specific gravities of two bodies, W and W′ their molecular weights, and V and V′ their molecular volumes. It will be convenient to take the density of carbonic acid at the critical point as the standard density to which the others can be referred. The density of carbonic acid under such conditions may be taken as 0·65. Calculating with the above formula, the density of acetylene would be 0·32, whereas the experimental number of Ansdell is 0·36. In the same way the density of hydrochloric acid is found to be 0·6, the true value being 0·61. The density of oxygen would be 0·63, and that of nitrogen 0·45. The calculated density of hydrogen at its critical point would be 0·12, if we assume the correctness of Sarrau's values for the critical temperature and pressure. We may compare these values with the numbers obtained by Cailletet and Hautefeuille for the densities of oxygen, nitrogen, and hydrogen from their experiments on the density of liquid carbonic acid obtained from mixtures of this body with these gases. At the temperature of 0° C. the experiments found for oxygen, nitrogen, and hydrogen the respective values of 0·65, 0·37, and 0·025. It seems that the calculated values for oxygen and nitrogen are not very far wrong; but hydrogen is clearly incorrect. The explanation of this anomaly is probably to be found in the fact that the calculated molecular volume of hydrogen is wrong, and that instead of being unity on our scale it ought to be 3·5 like oxygen and nitrogen. In fact, the chemist would infer that, as the difference in the complexity of the molecular structure of hydrochloric acid, water, ammonia, and marsh-gas does not affect the molecular volume under the conditions we are discussing, in all probability the value for hydrogen would be identical with that of the above-mentioned bodies. If we adopt this view and change the value of the $T_c \div P_c$ to 3·5, then the density of the fluid would become 0·034, which is in accordance with the experimental number of Cailletet and Hautefeuille. An accurate determination of the critical temperature and pressure of hydrogen, for which, judging from the success of the experiments of M. Olzewski, chemists will not have to wait long, will thus be of great interest.

SEPARATION AND DETERMINATION OF POTASH IN COMMERCIAL FERTILISERS.*

Boil 10 grms. of the fertiliser with 5 c.c. strong hydrochloric acid and 300 to 400 c.c. of water for ten minutes. Cool the solution, and, without filtering, make it up to 1000 c.c.; mix thoroughly, and filter through a dry filter.

Take an aliquot corresponding to 0·5 or 1·0 grm., dilute if necessary to about 150 c.c., heat to boiling, and precipitate the sulphuric acid with a slight excess of barium chloride solution. Without filtering add an excess of barium hydroxide, and heat again to boiling. Filter and wash, at first by decantation, till the washings are free from chlorides. Heat the filtrate nearly to boiling and precipitate the barium salts with ammonium carbonate and a little ammonia solution. Filter and wash; evaporate filtrate and washings to dryness, and ignite *below a red heat* till the ammonium salts are removed and the organic matter is oxidised as completely as possible. The residue, consisting of chlorides of potassium and sodium, with some charcoal and possibly a little barium salt which escaped precipitation, is digested with hot water; a few drops of ammonium carbonate are added, and the solution filtered and washed. The filtrate and washings are again evaporated to dryness and ignited gently.

The mixed chlorides are dissolved in water, an amount of platinum tetrachloride solution is added more than sufficient to form the double salt with all the potash and *soda* present, and the solution is evaporated at or below 100° C., so nearly to dryness that it becomes solid on cooling. To the cold mass 10 to 20 c.c. of strong alcohol (80 p. c. to 95 p. c.) are added and the mass is well broken up with a stirring rod or pestle. After standing 5 to 10 minutes the supernatant liquid, which must have a reddish colour from excess of platinum tetrachloride, is poured on a filter; more alcohol is added to the mixture of the double salts, and the whole stirred and pulverised and washed by decantation until the washings are perfectly colourless.

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* Methods adopted by the Association of Official Agricultural Chemists, for use during the season of 1884-5.

The precipitate is then brought on the filter by means of a wash bottle containing alcohol. The salt is dried at 100° C. and weighed. After weighing, the salt is dissolved from the filter with hot water and the filter is dried and weighed together with any platinum which may have been reduced in drying down the solution with platinum tetrachloride, or other impurities. The actual potash is reckoned from the weight of the double chloride of potassium and platinum by multiplying by 0·19308.

Potassium chloride is reckoned from the double salt by multiplying by 0·3056. These factors are based on the following atomic weights:—

Platinum	197·18
Potassium	39·13
Chlorine	35·46
Oxygen	16·00

EXAMINATION OF POTABLE WATERS FOR MICROBIA.

By Herr BRAUTLECHT.

From 50 to 100 c.c. of the water are mixed with 5 drops of a solution of 1 part aluminium sulphate, 1 part hydrochloric acid, and 8 parts water. From 1 to 3 drops of a 10 per cent liquid ammonia are added, when a moderate precipitate is formed, which entangles and carries down all the microbia. After it has subsided the clear liquid is decanted off, and the rest is poured upon a filter of smooth paper. When the precipitate has drained it is stroked off with a glass rod, placed in a test-tube, and dissolved with from 10 to 15 drops of acetic acid. Occasionally, though seldom, an addition of hydrochloric acid is needful. The liquid must not appear opalescent, but after the settlement of any organised matter (which by this process is concentrated into the smallest space) must be clear. The organisms are placed on a slip without any addition, and examined under the microscope, after removing any excess of liquid with filter-paper. The image obtained can be made more distinct by the addition of a little clear solution of saffranine. If the acetic acid used for dissolving the precipitate is mixed with one-half per cent of gelatin permanent preparation can be made and preserved according to the method of Ehrlich and Koch, by drying up on the glass cover, colouring, &c.

In the Imperial Sanitary Office the examination of water for microbia capable of development is conducted as follows:—200 c.c. of the water are placed in carefully cleansed vessels, disinfected by hot steam, and stoppered with cotton-wool similarly disinfected. The pipette used in taking the sample is each time rinsed out several times. For the direct microscopic examination the water is well shaken up, and a drop is placed upon a glass cover: the latter, with the drop turned downwards, is laid upon a glass slip with a ground concavity, and is examined first with a magnifying power of 100 and then of 500. Several glass covers receive each a drop of the same water, and are put to dry in a place free from dust and other impurities. After the drops have evaporated (fifteen to twenty minutes) the residue on the covers is coloured in the ordinary manner with methylene-blue, dried, laid in Canada balsam, and examined with a magnifying power of 500, when the dyed bacteria appear very distinct.

In order to determine the number of the microbia in the water, a corresponding quantity is mixed with 10 c.c, of a liquefied culture-gelatine, which has been previously sterilised at a boiling-heat. The quantity of water to be used must be determined by preliminary experiments and ranges between 1-1000th of a drop and 10 drops. The number of drops is always measured off with the same pipette, which is on each occasion repeatedly rinsed out first with distilled water, recently boiled, and then several times with the water under examination. The liquid culture-gelatine, mixed with water, is immediately poured out in a cold place upon a perfectly horizontal glass plate, which has been previously disinfected by heat. When the gelatine has congealed the plate is laid in a moist space (under a glass bell), and is preserved in a heated room. In the course of forty to sixty hours a number of vegetative colonies, corresponding to the number of germs pre-existing in the water, is developed in the form of larger or smaller points and drops of different colours which liquefy the gelatine here and there. The number of these colonies is thus determined:—Beneath the glass plate is placed a second glass plate, upon which lines have been engraved, forming meshes of a centimetre square. In several of these meshes the number of the colonies developed is counted under a magnifying power of 30; the average is calculated and multiplied by the total number of square centimetres occupied by the gelatine. The number thus obtained is of course merely approximate. On repeated experiments it was found that 1 c.c. of boiled distilled water gave only 4 to 6 colonies. Water from various wells in Berlin gave per c.c. 40 to 160, but in some cases 4000 to 12,000; the conduit water in the Sanitary Office, 160 to 250; unfiltered sewage from the pressure-pipe in Falkenberg, 38,000,000 colonies, of which 980,000 liquefied gelatine.

If a sunbeam is allowed to pass through a glass filled with water and protected from side-light by means of a covering of black paper, in such a manner that the ray enters through a rectangular hole in the paper, and is observed through a second opposite hole, we observe, according to Marchand, hyaline bodies of different forms. They are said to possess a greater density than sea-water (1·026), and resist dilute acids and alkalies. Marchand found these corpuscles in all bodies which he has hitherto examined, even in distilled water after a short exposure to the air. Although they are about 2 m m. in diameter they pass through every filter. The author believes that these organisms effect important chemical transformations.—*Zeitschrift fur Analytische Chemie.*

ON COMBINATIONS OF SILVER CHLORIDE, BROMIDE, AND IODIDE WITH COLOURING MATTERS.

By M. CAREY LEA, Philadelphia.

While studying these silver salts, in May last, I found that they had the remarkable property of entering into chemical combination with many colouring matters very much in the same way that alumina does, though not to the same extent, forming what may be called lakes. It is only necessary to bring freshly precipitated and still moist silver salt into contact with the colouring matter, or to make the precipitation in the presence of the colouring matter if the latter is not precipitated by silver nitrate, when the combination takes place and the colouring matter cannot be washed out by any amount of washing. A prolonged absence following immediately after has prevented the continuation of the investigation. It is still incomplete, and the leading facts only are mentioned here to take date.

Not all colouring matters are capable of uniting with the silver salts, but the number of those that do so unite is considerable. What is curious, and tends to show that the combination is intimate, is that the colour assumed by the silver salt is not always that of the dye, but may differ from it considerably. Also the three silver salts may be differently coloured by one and the same colouring matter.

More frequently, however, colouring matters impart their own shade, or something approaching to it: thus, silver bromide precipitated in presence of excess of silver nitrate takes from aniline purple a strong purple colour, from cardinal red a bright flesh or salmon colour, from naphthaline yellow a light yellow colour, from eosin a brilliant pinkish or salmon, and so on.

Different specimens of the same colour gave sometimes quite different results; thus silver bromide precipitated in presence of silver nitrate was dyed by one specimen of methyl green to a bluish green. Another specimen of the same colour obtained from a different source coloured the same silver salt a deep purplish shade. Silver iodide showed the same difference.

Sixteen years ago I proposed to colour or stain the photographic film, in order to modify its behaviour towards light, principally to prevent blurring or irradiation.*

Of many colouring matters then tried, the best proved to be litmus coloured red by acetic acid. This was very effectual for the purpose, and was long used by others as well as myself. So far as I have been able to ascertain it was the first suggestion made of this mode of acting on the sensitive plate. Since then staining the film has been found to have other applications, and many others have experimented in this direction, in most cases with a view to alter its sensitiveness relatively to the different colours of the spectrum. Major Waterhouse was, I believe, the first to recognise this effect.

Dr. John W. Draper appears to have first advanced the view that substances sensitive to light are affected by the rays which they absorb. There is much to support this theory, although it cannot be considered as definitely established.

Some years since Dr. H. W. Vogel expressed the opinion that when sensitive films were washed over with solutions of colouring matters, the films gained sensitiveness to those rays of the spectrum which the colouring matters absorb, with this condition, that the colouring matter in question must be capable of combining with Cl, Br, or I, as the case might be. My own results were different. I found that the action of the rays was profoundly modified by colouring the film, but the result did not seem to conform to any law, and as often contradicted Vogel's view as agreed with it.

Vogel's theory necessitates the assumption that the colour imparted to the silver salt is identical with that of the dye used, and, as has been shown above, that by no means follows. He supposed that the capacity of any given colour to influence the silver salt depended upon its tendency to combine with Cl, Br, and I, whereas, as we have above seen, its action most probably depends upon its ability or inability to combine with the silver haloid.

But the principal source of error has arisen from the fact that when the film is stained the effect is necessarily a confused one. Besides any influence that may be exerted on the particles of silver haloid, these particles are virtually behind a colour screen, which must materially modify the nature of the light that reaches them, and the final effect must necessarily be a combination from two distinct causes. Moreover, the colour in the film tends to arrest precisely those rays to which it is proposed to render the silver salt more sensitive,—a consideration of the utmost importance, for the one action tends to counteract the other, and thus leads to inextricable confusion. From a system of experiments so faulty no just conclusions could be drawn.

Whether, with these sources of error eliminated, Draper's view—that a sensitive substance is influenced by those rays which it absorbs—can be applied to these new combinations which I have here described, is a matter on which I am not prepared to express an opinion, having been, much to my regret, unable as yet to examine the question. It seems *à priori* probable, but in that case it is important to observe that the effect will depend, firstly, upon the capacity of the dye to combine with the silver haloid; and secondly, not on the proper colour of the dye isolated, but on the colour that the silver haloid acquires under its action, which, as we have already seen, may be something quite different from the colour of the original dye.

I have observed that the silver salts are greatly changed by conversion into lakes, even when the colour imparted is but faint. They become in some cases much more finely divided, and remain long in suspension. In one case at least, a great increase of sensitiveness to light for development was observed. Later I shall hope to give more definite details on these points.

In the above facts will doubtless be found an explanation of many of the anomalies in the behaviour of coloured films which have caused such wide differences of opinion. And the new modes of operating deducible from the reactions here described will, I think, be found of extended utility. Silver salts can be dyed first and emulsified afterwards, and the ability to colour the sensitive salt to any shade with certainty, and without introducing a counteracting influence into the film, gives a new power in photo-chemistry.—*American Journal of Science.*

THE FUSION, CASTING, DEPHOSPHORISING, AND PLATING OF IRIDIUM, TOGETHER WITH A BIBLIOGRAPHY OF THE SUBJECT.

By NELSON W. PERRY, E.M.

(Concluded from page 21.)

Applications.

Among the applications rendered possible by Holland's process, and now successfully in operation, may be mentioned:—

(1) *Draw Plates* for brass, gold, silver, platinum, copper, and very fine iron wire—supplanting for this purpose steel and the ruby; the advantages claimed for it being that it has no "temper" to be drawn, as has steel, and being harder will outlast it, and that it is tougher than, and not so liable to break as, the ruby.

(2) *Knife Edges* for fine analytical balances. It seems to have less friction than steel, is not magnetic, and is uncorroded by dampness or acid fumes. Mr. Troemner, of Philadelphia, has made practical tests of its adaptability in this direction. His first balance was provided with iridium knife-edges in the latter part of 1881. This trial so fully satisfied him of its superiority to steel for such purposes that he now uses the phospho-iridium exclusively on his finer balances.

(3) *Small Drills* for jeweller's work, drilling the eyes of buttons, &c. Is harder than steel, and has no temper to be drawn.

(4) *Electrical Contact Points.* Replacing platinum, with which it has similar electrical properties. The dephosphorised metal is here used. Does not "stick" nor oxidise, as does platinum. Some of these points have now been in constant use for a year and a-half by the Western Union Telegraph Co., and the Union Switch and Signal Co., of Pittsburg, without signs of deterioration.

(5) *Stylus Points* for manifold writing.

(6) *Negative Electrodes* in the arc lamp. It was not found suitable for the positive electrode, as the heat was so intense as to partially fuse it, but as a negative electrode in a lamp having carbon as a positive it seems to answer very well. The heat in the negative is not sufficient to melt it, but simply enough to make it malleable. The difficulty has been that the lamps as ordinarily constructed permit of the hammering of the negative by the positive electrode. This is sufficient in time to batter the iridium out of shape. Experiments have been made to prevent this hammering, and, I am reliably informed, very successfully. Mr. N. L. Egerton, of Philadelphia, has constructed such a lamp that meets all the requirements. I have been unable to get any details of his ex-

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* *British Journal of Photography*, 1868, 210, 506; 1870, 145, &c.

periments, and therefore cannot give them. Messrs. Holland and Dudley provided a Maxim lamp with the iridium electrode, and operated it for 168 hours. The iridium used was weighed, both before and after the experiment, and there was no sensible loss of weight. This lamp was one of the pounding kind, and after being in use for this length of time the iridium was so battered out of shape as to put a stop to the experiment. The advantages of the use of iridium in a properly constructed lamp readily suggest themselves, viz.: the unvarying position of the point of light, thus adapting the arc light to conical and other reflectors without additional machinery; the shortening of the length of lamp by nearly the length of the usual negative carbon, and the saving in running expenses of negative carbons.

It is also claimed that a considerable increase of light is obtained by its use, and that the quality is superior, being less glaring. To the truth of the latter statement I can testify from personal observation.

Edison and others have experimented with iridium for incandescent lighting, but not with encouraging results.

(7) *Tipping of Gold Pens* and McKinnon pens.

(8) *Tipping of Blowpipes.*

(9) *Jewels and bearings* for delicate machinery, such as watches, clocks, &c.

(10) *Anodes* for electro-plating with same metal.

(11) *Tips* for hypodermic syringes, &c.

(12) *Bearings* for magnetic compasses.

(13) *Edgings* for tools used in turning rubber, ivory, celluloid, and such other substances as readily draw the temper of steel; and, in fact, for all such purposes as demand a metal that will withstand both chemical and mechanical abrasion the iridium seems unrivalled.

(14) The electro-plate is used where an indestructible coating is desired, and where the additional expense would not prevent its supplanting silver or nickel plate. Its extra durability, almost indestructibility we may say, and the fact of its never tarnishing, are qualities that recommend it above all other metals for plating, and in many cases largely outweigh its additional cost.

I purposely avoid giving any prices, as they are constantly changing as improvements are made. A basis for calculation, however, may be had by taking the price of phospho-iridium as a starting-point. The American Iridium Company now place a value upon it of 20 dollars per ounce troy.

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ABSOLUTE ALCOHOL.*

(Concluded from page 22.)

Taking the 15·6° C. standard for unity, and weighing at this same temperature, and without other correction for buoyancy of air than that by the use of a counterpoising flask, two specific gravities of 0·79349 were obtained, three of 0·79350, and three of 0·79351. The mean of these eight successful weighings is so nearly 0·79350 that this number is accepted as the present specific gravity. Over 20 weighings were obtained below 0·79367. Alcohol of a sp. gr. of 0·79350 at 15·6° C, gave, at 4° C., compared with water at 4° C. as unity, a specific gravity by careful observation of 0·802566. At 15° C., compared with water at 4° C., the apparent sp. gr. was 0·79348. This, corrected for expansion of glass, gave 0·79326. At 15·6° C., compared with water at 4° C., the apparent sp. gr. was 0·79301. This, corrected for expansion, gave 0·79279. At 25° C., compared with water at 4° C., the apparent and corrected specific gravities were 0·78557 and 0·78496; and at 25° C., compared with water at 15·6° C. as unity, the apparent and corrected specific gravities were 0·78591 and 0·78573.

Similar lines of weighings, with the exception of that at 15° C. were then made with combinations of this alcohol and recently boiled distilled water. The first with 99 per cent by weight and 1 per cent of water; then 98 per cent and 2 per cent water; then 96 per cent, and then at intervals of 4 per cent down to and including 40 per cent alcohol and 60 per cent water, and a table is submitted below of these actual weighings. The column of 15° C. compared with water at 4° C., has only four weighings, the remaining figures being the result of interpolations based upon the four weighings. All the specific gravities were weighed and are stated to the fifth decimal place, but the last decimal is only given for its effect upon the fourth, for it is not pretended that any ordinary balance or management will give correct figures for the fifth decimal place, even when a sp. gr. flask so large as 500 grms. is used.

The columns under the head of corrected specific gravities are corrected simply for expansion of the glass flask, and for the sake of those readers who may, like the writer, be no algebraists, and yet who may wish to make such corrections of apparent or observed specific gravities, the arithmetical rule for correction will be given.

The cubic expansion or holding capacity of ordinary glass vessels is increased by heat at the rate of 0·000025 of its capacity for each degree of the centigrade scale, and therefore a flask which holds 1000 grms. of water at 4° C. will hold 1000·025 grms. at 5° C., or (0·025 × 11 =) 1000·275 grms. at (4° + 11° =) 15° C. Therefore the expansion for 1° C. must be multiplied by the number of degrees of difference in temperature between that of the standard volume for unity and that at which the weighing is made. This gives the total correction for unity. This must be multiplied by the number of units of weight which the flask may hold in order to get the total correction to be applied to any given flask. Suppose a flask which holds to the mark exactly 500 grms. of water at 4° C. be filled to the same mark with alcohol at 15° C., and is then found to contain 396·75 grms. of the alcohol. The correction for unity being 0·000025 for each 1° C. and the difference in temperature between the standard of volume—namely, 4° C., and the volume at the weighing—namely, 15° C., being 11° C., the 0 000025 mulplied by 11 gives 0·0000275, which is the total expansion per unit. Then as there are 396·75 units, this multiplied by the 0·000275 gives 0·10910625 as the total correction to be subtracted from the weight of the alcohol, because the flask by expansion through 11° C. of temperature holds 0·109 + grm. more than it does at 4° C. Then by the common rule that a decimal fraction of 5 or more than 5 in one decimal place is to be carried as a unit to the next decimal place to the left, while one of less than 5 is to be dropped—this correction becomes practically—not 0·1091+, but 0·11. This subtracted from 396·75 gives 396·64 as the weight of the volume of this alcohol, which is exactly equal to the volume of water at 4° C., and this is therefore the volume corrected for expansion of glass vessel. Now, if this series of figures be doubled, the capacity of the flask for water at 4° C. will be 1000 instead of 500. The alcohol will weigh (396·75 × 2 =) 793·50, instead of 396·75, and this with the decimal point moved three places to the left will be the apparent specific gravity, because the figures 1000 are to be converted into unity of 1·000. Then the correction will be (11 × 2 =) 22, instead of 11, and this correction applied to the 793·50 will reduce it to 793·28, and the moving of the decimal point three places as before, which is equivalent to dividing the number by 1000, gives 0·79328 as the true or corrected specific gravity of this alcohol at 15° C. compared with water at 4° C. It will now be seen that the figures 793·50, whether taken as 793·50 or 0·79350, equally represent the accurate weight of alcohol to which the correction is to be applied. But these figures also represent the apparent

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* From An "Ephemeris of Materia Medica, Pharmacy, Therapeutics, and Collateral Information," by E. R. Squibb, E. H. Squibb, and C. F. Squibb.

ALCOHOL TABLE.

Showing the specific gravities of combinations of alcohol and water, ascertained by actual observation at intervals of 4 per cent., on the new basis for absolute alcohol of sp. gr. 0·79350, at 15·6° C. = 60° F. compared with water at 15·6° C. = 60° F. as unity; and showing both the apparent and corrected specific gravities at different temperatures by the two common standards for unity, namely, water at its maximum density of 4° C. = 39·2° F. and at 15·6° C. = 60° F. The Table is sufficiently correct to be practically useful to the fourth decimal place.

P. c. by Weight.	Compared with Water at 4° C. = 39·2° F. as unity.							Compared with Water at 15·6° C. = 60° F. as unity.		
		Weighed at—							Weighed at—	
	4° C.=39·2° F.	15° C. = 59° F.		15·6° C. = 60° F.		25° C. = 77° F.		15·6° C.=60° F.	25° C. = 77° F.	
	True.	Apparent.	Corrected for expansion of glass.	Apparent.	Corrected for expansion of glass.	Apparent.	Corrected for expansion of glass.	True.	Apparent.	Corrected for expansion of glass.
100	0·80257	0·79348	0·79326	0·79301	0·79279	0·78537	0·78496	0·79350	0·78591	0·78573
99	0·80579	0·79667	0·79645	0·79618	0·79595	0·78847	0·78806	0·79669	0·78901	0·78882
98	0·80875	0·79965	0·79943	0·79893	0·79870	0·79131	0·79089	0·79967	0·79205	0·79186
96	0·81467	0·80555	0·80533	0·80509	0·80486	0·79744	0·79702	0·80558	0·79801	0·79782
92	0·82593	0·81680	0·81658	0·81631	0·81607	0·80865	0·80823	0·81684	0·80915	0·80896
88	0·83649	0·82751	0·82728	0·82699	0·82675	0·81929	0·81886	0·82755	0·81982	0·81963
84	0·84681	0·83770	0·83747	0·83719	0·83695	0·82953	0·82909	0·83775	0·83007	0·82987
80	0·85683	0·84773	0·84750	0·84718	0·84694	0·83959	0·83915	0·84779	0·84021	0·84001
76	0·86655	0·85742	0·85718	0·85699	0·85674	0·84937	0·84892	0·85749	0·84991	0·84971
72	0·87600	0·86702	0·86678	0·86649	0·86624	0·85895	0·85850	0·86711	0·85953	0·85933
68	0·88516	0·87655	0·87631	0·87607	0·87582	0·86847	0·86801	0·87665	0·86905	0·86885
64	0·89479	0·88625	0·88601	0·88578	0·88552	0·87832	0·87786	0·88636	0·87884	0·87863
60	0·90401	0·89549	0·89524	0·89556	0·89530	0·88766	0·88719	0·89561	0·88821	0·88800
56	0·91297	0·90452	0·90427	0·90405	0·90379	0·89687	0·89640	0·90465	0·89745	0·89724
52	0·92177	0·91349	0·91324	0·91309	0·91283	0·90597	0·90549	0·91365	0·90653	0·90632
48	0·93045	0·92231	0·92206	0·92187	0·92160	0·91489	0·91441	0·92247	0·91547	0·91525
44	0·93875	0·93082	0·93056	0·93045	0·93018	0·92361	0·92313	0·93101	0·92427	0·92405
40	0·94655	0·93901	0·93875	0·93865	0·93838	0·93217	0·93168	0·93923	0·93275	0·93253

specific gravity, and, therefore, as a short cut across all this roundabout analysis of the operation, the following simple rule by which to correct for expansion of glass is reached.

Multiply 0·000025 by the number of degrees of difference between the temperature of the standard volume for unity and that at which the liquid is weighed, for the total correction for unity; then multiply the apparent specific gravity by this total correction for unity, to obtain the total correction for the whole quantity: subtract this from the apparent specific gravity, and the result will be the corrected specific gravity.

By this rule the corrected columns of the table are all obtained.

To all those thoroughly educated persons who can comprehend the algebraic formula $V' = V(1 + Kt)$, as this writer cannot, the above explanation, and much of the preceding detail, will seem prolix and useless. But so many are still to be found who are puzzled, confused, and obstructed by algebraic formulæ, who yet have the appetite for such work, and the capacity to do it with care and patience, that it has been thought worth while to go into much detail in this paper, which will be the surplusage of the poorest kind to many readers.

When examined by the differences the results given in this table are only in fair practical accord, and are entirely wanting in the regularity of a mathematical table. The discords are mainly confined to the fifth decimal place. They often reach the fourth decimal place, but never the third, and these differences have a curious wave or curve which reaches its maximum between 64 and 68 per cent. When compared with the older table of the writer, republished farther on in this paper, this curve is quite marked, and very strongly suggests a curvature in the line of expansion of combinations of alcohol and water by heat, but the observations were not sufficiently accurate to be trustworthy at the decimal place of hundred thousandths, and make no pretension to such accuracy. They are given simply because they occur naturally in weighing to centigrammes with a 500 grm. sp. gr. flask, and to give a certain indication of the value of the figure in the preceding decimal place. The lower and more important specific gravities for absolute alcohol were all taken with the flask illustrated in this paper, and are believed to be quite trustworthy. But three of these dilutions were weighed with the specific gravity flask illustrated at p. 9; the remainder being weighed in the flask illustrated in a former paper, and therefore are less accurate.

The entire subject well merits a more thorough and careful investigation, and if this paper should awaken an interest in it in some one with more ability and time than this writer has, it will serve a very good purpose indeed.

ADDENDA.

Some work was prepared which through accident was omitted altogether, and may be briefly given here.

The coefficient of temperature as ascertained by actual observation is, for this absolute alcohol, when compared with water at 4° C., 0·0008463 for each 1° C. up to 15° C. And between 15° C. and 25° C. it is 0·000830 for each 1° C.

Compared with water at 15·6° C., as unity, the coefficient is 0·0008266; and these coefficients are only fairly uniform through the dilutions down to about 80 per cent strength. They then diminish somewhat rapidly, and not regularly—that is to say, not mathematically.

The coefficient deduced from the specific gravities of Mendelejeff for absolute alcohol at this range of temperature is 0·0008387. The application of this to his specific gravity at 0° C. makes his specific gravity at 15° C. 0·79367. But the application of the coefficient obtained by the writer, as above given, makes Mendelejeff's sp. gr. at 15° C. 0·79356. So also by his own coefficient his sp. gr. at 4° C. is 0·80290, while by the coefficient of this writer it is 0·80286.

Since the publication of the paper some critical tests for the absence of water not before noticed have been tried.

The test of Cassoria, of shaking absolute alcohol with white, dried, or anhydrous sulphate of copper, when if water be present the sulphate will be hydrated by it, and turn blue, is fallacious, although given as being trustworthy by all the authorities examined excepting one. Absolute alcohol of a sp. gr. of 0·7936 at 15·6° C., compared with water at 15·6° C. as unity, when diluted with 0·5 per cent water stands this test. This same dilution also stands the test of forming a perfectly clear solution with all proportions of carbon disulphide and of oil of copaiba. Neither does alcoholic solution of caustic baryta give any reaction. In short, no test has been yet proposed that will detect the water present in alcohol which contains less than about 0·1 per cent.

A very recent distillation of absolute alcohol of over 60 gallons, made in hot weather, when the air was full of moisture, and a considerable exposure to the moist air unavoidable, had a sp. gr. of 0·79360 at 15·6° C. compared with water at 15·6° C. as unity. This supports the conclusion that the limit of dehydration, even by lime, has not yet been reached, and in order to be able to examine the subject further, and with more accuracy, the writer has set up a large percolator containing some 60 pounds of quicklime that was ground, and the finer particles sifted out. It was then put on to a plumbago crucible, and subjected to a white heat in a blast-furnace during five hours, and transferred to the percolator when cool enough to be handled. Through this lime about 16 litres of the absolute alcohol of the preceding paper is to be slowly passed and re-passed without contact with undried air until the cold weather of next winter, when the writer hopes to return to the subject.

NOTE ON OZOCERITE.

By FRANKLIN S. SMITH.

In the clay fields of Mr. Otto Ernst, of South Amboy, N.J., specimens of ozocerite have recently been found. In a letter Mr. Ernst writes:—"I do not think it likely that I shall find any paying quantities of it, though I recollect finding a lump ten times as large some years ago. Its low specific gravity probably carried it here by waters from the petroleum fields."

The specimen was in the form of an irregular lump, about three-quarters of an inch in its longest diameter. The colour was nearly pure.

A combustion gave—

		Calc. for C_6H_{10}.
Carbon	86·46	85·71
Hydrogen	12·83	14·29
	99·29	

The substance was not purified, so that the above results are, of course, only approximate. There is little doubt, however, that the hydrocarbons belong to the series C_nH_{2n}, as stated by Grabowski.—*American Chemical Journal.*

NOTE ON SILICEOUS EARTH.

By J. W. McKELVEY.

In a small basin on the farm of Mr. D. Judson Cook, which is located near Drakesville, Morris County, New Jersey, there is a deposit of infusorial earth which covers about 3 acres. The first stratum, which begins at the surface, is peaty to a depth of about 1 foot. The next is infusorial earth to a depth of 3 feet, and then come 7 feet of a white sandy clay. At the bottom of this there is a deposit of gravel and cobble-stone drift. The white clay seems to be a mixture of clay and infusorial earth. Near the edge of the bed it grows thin, and the upper 15 inches of the 3-feet layer are more porous than the rest.

This infusorial earth is of a greyish white colour, and on igniting becomes perfectly white. It contains small fragments of leaves and twigs.

The specific gravity of the sample was 1·11. On analysis it gave—

Silica	80·66	per cent.
Alumina	3·84	,,
Lime	0·58	,,
Loss on ignition	14·01	,,
	99·09	,,

—*American Chemical Journal.*

CHEMICAL NOTICES FROM FOREIGN SOURCES.

Note.—All degrees of temperature are Centigrade unless otherwise expressed.

Comptes Rendus Hebdomadaires des Séances, de l'Académie des Sciences. Vol. xcix., No. 25, December 22, 1884.

New Method for Measuring the Combustion-Heat of Carbon and of Organic Compounds.—MM. Berthelot and Vieille.—The authors effect the combustion in their "calorimetric bomb" with oxygen at a pressure of 7 atmospheres, and with such a weight of the combustible that the quantity of oxygen consumed may not exceed 30 to 40 hundredths of its initial quantity. These conditions are easily realised by means of a small condensation-pump, and are applicable to all bodies which do not give off vapours possessing a sensible tension at the ordinary temperature.

Thermo-dynamic Potential and the Theory of the Voltaic Pile.—P. Duhem.—The author establishes the following theorems:—In order that a system may be in stable equilibrium every virtual isothermic modification of such system must correspond to an uncompensated null or negative work. The chemical reaction produced in elements would furnish, if not collected by the current, a quantity of heat Q compensated, and another quantity Q′ not compensated. Then the heat evolved in the battery when in action = Q + Q′. The voltaic heat, that is to say, the quantity $A r i^2$ (in which r represents the resistance of the circuit, and i the intensity of the current, is equal to the non-compensated heat Q′. The excess of the chemical heat over the voltaic heat is therefore equal to positive or negative quantity Q.

Combustion-Heat of Ethers of Some Acids of the Fatty Series.—W. Louguinine.—The result of the author's experiments is that the combustion-heat of the ether of an acid is approximately equal to the sum of the combustion-heats of the acids and the alcohol of which it is formed, taking account of the number of the molecules of alcohol which participate in this formation.

On α-Ethyl-amido-propionic Acid.—E. Duvillier.—This acid is deposited from its watery solution in large clino-rhombic crystals containing a half-molecule of crystalline water, which they lose at common temperatures on prolonged exposure over sulphuric acid. The acid crystallises from boiling alcohol in nacreous tablets. At 25° the acid dissolves in rather less than twice its weight of water and in about fifty times its weight of alcohol. If carefully heated it is volatilised without melting or blackening. Its composition is C_5H_{11},NO_2.

Zeitschrift für Analytische Chemie.
Vol. xxiii., Part 4, 1884.

Action of Copper Hydroxide upon certain Sugars. J. Habermann and M. Honig.—The authors have extended their former researches to lactose, maltose, sorbin, dulcite, and mannite, upon the two last of which there is no action.

Determination of Nitrogen in Organic Substances.—H. Grouven's method (*Zeit. Anal. Chem.*, xxii., 108 and 439) has been carefully examined by M. Märcker, U.

Kreussler, and H. Landolt, who all agree that the results are unsatisfactory. Kjeldahl's method (*Zeit. Anal. Chem.*, xxii., 365) has also been carefully re-examined, and is pronounced not merely more accurate than the Varrentrapp-Will process, but is cheaper, takes up less time, and is much more convenient for dealing with liquids. The product of distillation is always colourless, so that rosolic acid can be used as indicator in titration. Paul Wagner determines nitrogen present as ammonia by means of the azotometer. For organic nitrogen he uses a modification of the Varrentrapp-Will process, and for nitric acid that of Schlösing-Grandeau. He also shows that Ruffle's method is applicable to the determination of nitrogen in Peruvian guano containing nitrates.

Determination of Sulphurous Acid in tho Atmosphere of Lille.—M. Ladureau.—In calm weather 2·2 c.c. of sulphurous acid were found per cubic metre.

Detection of Microbia in Potable Waters.—Herr Brautlecht.—Inserted in full.

Distinction between Rye- and Wheat-Flour in Mixtures.—M. Kjärsku.—The author removes the albumenoids by steeping the sample for twenty-four hours in an excess of Ritthausen's solution of potassa (1-1000), syphons off the liquid, shakes up the residue with water, and lets it settle. By continued careful elutriation the characteristic granules can be obtained in a state fit for the microscope.

Analysis of Butter.—Herr Reichert.—The author confirms the modification of his process suggested by Meissl, but rejects that of Meunier.

Distinction between Tallow and Lard.—M. Belfield.—The author compares the crystals obtained from the ethereal solutions of these fats.

A Remarkable Property of Olive Oil.—Serra Carpi.—If fatty oils oils are cooled down to −20°, and kept at this temperature for three hours, they assume very different degress of hardness, olive oil being the hardest. To determine this point the author uses a cylindrical iron rod, 1 centimetre in length, and ending below in a cone. Upon it is exerted a pressure measured in grammes until it penetrates into the oil with its entire length. The best olive oil required a pressure of 1700 grms., whilst cotton oil required only 25 grms.

Specific Gravity of Cacao Oil.—E. Dieterich.—According to the author this oil ranges from 0·979 to 0·982. Its melting-point is 31·4°.

Researches on Kerosines.—J. Biel.—The author makes use of the distillation method. According to Mendelejeff the specific gravity of the distillates from the Baku oil does not always increase with the boiling-point.

Colorimetric Determination of Carbon in Iron and Steel.—M. Stead.—One grm. of the substance is treated in a covered beaker with 12 c.c. of nitric acid (1·20 sp. gr.), and heated to 90° to 100°, when it dissolves in about ten minutes. A similar weight of a sample of normal iron containing a known proportion of carbon is treated in the same manner, and to each solution there are then added 30 c.c. water and 13 c.c. soda-lye at 1·27 specific gravity. After well shaking they are diluted to 60 c.c., filtered through dry filters, and the intensities of the colours are compared, which are proportional to the quantities of carbon. The nitric acid used must be perfectly free from chlorine.

Examination of the Carbonaceous Residue of a Solution of Steel in Cuprammonium Chloride.—A. A. Blair.—From the *American Chemical Journal.*

Contamination of Commercial Sulphuric Acid with Selenium.—H. Drinkwater and J. Hamilton.—From the *Analyst.*

The Examination of Prussiate Melt.—K. Zulkowsky.—For determining the ferro-cyanogen the author prepares a semi-normal solution of potassium-zinc sulphate, measures off from 10 to 25 c.c. of it, dilutes with 20 to 40 c.c. water, heats to a boil, and lets the solution of prussiate melt run in until a spot-trial shows an excess of the latter. The liquid must be kept warm. For every 1 c.c. of liquid 0·5 m.grm. of prussiate solution are needed. To carry out this method about 50 grms. of the melt, coarsely powdered, are placed in a beaker with 150 c.c. of water, and let stand for two hours at a temperature of 40°. The contents of the litre are then rinsed into a ½-litre flask, which is filled up to the mark with water, filtered, and the filtrate is poured into a burette. 10 c.c. of the zinc solution are then measured into a beaker, 20 c.c. of water are added, and 5 c.c. of dilute sulphuric acid (1 : 5), heated to a boil, and the solution of the melt is run gradually into the hot liquid, stirring constantly. When the final reaction has been reached the value is determined more closely by a second titration. To determine the proportion of sulphocyanide, 50 c.c. of the solution are mixed with an excess of strong sulphurous acid, and allowed to stand for a day. Sulphur and a brown mass are deposited. The acid liquid is neutralised with zinc oxide, whereby a part of the ferrocyanogen is separated as a zinc compound. The rest is thrown down with zinc sulphate and filtered off. The neutral filtrate is concentrated on the water-bath, and is then mixed with sulphurous acid and copper sulphate, so that it becomes distinctly green. The white precipitate of copper sulpho-cyanide is filtered, washed, dried, and converted into copper sulphide in a Rose's crucible. The weight, multiplied by 1·223, gives the proportion of potassium sulpho-cyanide originally present.

The Analysis of Explosives.—W. Hampe.—This paper cannot be reproduced without the four accompanying illustrations.

The Composition and Analysis of Weldon Mud.—From the Chemical News.

Process for Determining Methylic Alcohol in Ethylic Alcohol.—Van de Vyvere.—No particulars are given.

Detection of Eosine in Textile Fibres.—The cloth or yarn is treated with a strong aqueous solution (1 : 4) of aluminium sulphate, applying heat. Cochineal and all other natural red dyes are stripped off; tar colours (magenta, saffranine, coralline) are dissolved, but eosine remains almost entirely untouched.

Valuation of Oak-bark and Nut-galls.—F. Musset.—This paper will be inserted in full.

Determination of Nitric Acid by Böhmer's Process.—H. Wilfahrt.—This memoir will be inserted in full.

The Proportion of Alkaloids in different kinds of Lupins.—E. Taeuber.—No particulars are given.

Examination of Quinine Salts.—M. Rozsnyay points out that these salts may sustain all the tests of the Pharmacopœia and yet be impure and sophisticated. He recommends the examination of solutions of these salts in polarised light.

Comparative Determinations of Morphine.—G. Hell.—No details are given.

Sodium Benzoate.—Communications on the examination of this substance have been made by several chemists, whose names are merely mentioned.

Determination of Chlorine in Urine.—Max Gruber.—Salkowski's modification of Volhard's volumetric process gives very satisfactory results.

Electrolytic Detection of Mercury.—C. H. Wolff.—The author has devised an apparatus by which it is possible to detect the 1-100th m.grm. of mercury in 100 c.c. of a liquid. The cathode consists of a pencil of fine silver wire, electro-gilded, upon which the mercury is deposited

Determination of Total Nitrogen in Urea.—Petri and E. Lehmann.—The authors recommend Kjeldahl's method.

Preparation and Quantitative Determination of Glycogen.—H. A. Landwehr.—The author mixes the solution of glycogen with ferric chloride and neutralises, when the entire glycogen is deposited as an iron compound.

Determination of Urea with Sodium Hypobromite.—Improvements on this process have been proposed by H. T. Hamburger and J. F. Eijkman, whose apparatus is figured and described.

On Mucuous Matters.—H. A. Landwehr.—The author enumerates several substances which, in addition to the albumenoids, are capable of producing mucin.

On Animal Gum.—H. A. Landwehr.—This substance occurs in metalbumen, in the mucin of the sub-maxillary glands, in cartilages, brain, and lungs.

On Acroglycogen.—H. A. Landwehr.—The author obtains this compound from the mucin of snails by treatment with potassa lye, which converts the mucin into an albuminate. He then precipitates all the albumen by alternate treatment with potassium, mercury iodide, and hydrochloric acid, and mixes the filtrate with excess of alcohol.

Detection and Determination of Arsenic.—T. D. Boeke.—From the Chemical News.

Detection of Chloral Hydrate in Milk.—A. Casali.—The author shakes up the milk repeatedly with twice its volume of ether and strong potassa lye; lets the whole stand for some time in a stoppered vessel, draws off the clear ethereal solution, and again shakes up the residue repeatedly with ether. The ethereal extracts are mixed and distilled. The chloral hydrate, or the products of its decomposition, pass over, and are sought for in the distillate.

Experiments on the Separation of Strychnine and Morphine from Fatty Animal Masses.—H. Focke.—This paper will be inserted in full.

The Poison of the Batrachians.—G. Calmels.—From the *Comptes Rendus.*

The Atomic Weight of Aluminium.—H. Baubigny.—From the *Comptes Rendus.*

Re-determination of the Atomic Weight of Titanium.—T. E. Thorpe.—From the Chemical News.

The Atomic Weight of Molybdenum.—Otto von der Pfardten.—The author's results confirm those of Dumas, Debray, Liechti, and Kempe.

The Atomic Weight of Tellurium.—B. Brauner.—The mean resulting from the author's experiments is 125.

Bulletin de la Société Chimique de Paris.
Vol. xlii., No. 12, December 20, 1884.

Note on the Use of Condensation in Fractionating Apparatus.—E. Claudon.—The power of a fractionating apparatus depends in great part on "bubbling"; the quantity of ascending vapour and that of condensed liquid in which the methodic washing takes place should be in a certain proportion. As this quantity of condensed liquid augments very rapidly with the boiling-point in one and the same apparatus when there is no special arrangement for regulating the condensation the dimensions of the apparatus must be varied.

Analysis of the Liquid of Hydrocele.—P. Devillard.—The author finds 9·71 of mineral matter in 1000 of the liquid. The albumenoid matters vary from 6, 7, to 10 per cent, and include albumen, met-albumen, par-albumen, fibrine, and hydropisine. Succinic acid is present.

Solubility of Mercuric Iodide in Water and Alcohol.—E. Bourgoin.—A litre of water at 17·5° dissolves 4 centigrammes of mercuric iodide. The solubility is doubled on adding to the water 10 per cent of alcohol at 90°. The quantity dissolved increases with the temperature, and in alcohol is so much the greater as the latter is more concentrated.

Action of Metals upon Chloral Hydrate.—S. Cotton.—Most metals if brought in contact with an aqueous solution of chloral hydrate decompose it, with formation of a corresponding metallic chloride. The decomposition varies with the temperature, with the nature of the metal, and with its state of division.

Journal für Praktische Chemie.
New Series, Vol. xxx., Parts 4 and 5.

Certain Derivatives of Cyanethine.—Carl Riess.—The author describes the action of bromine upon cyanethine, the production of mono-brom-cyanethine and its salts; the bases derived from mono-brom-cyanethine, its behaviour with sodium ethylate; the action of nitrous acid upon ethoxyl-cyanethine; its behaviour with strong hydrochloric acid; the action of sodium methylate upon mono-brom-cyanethine; the behaviour of nitrous acid with methoxyl-cyanethine; the action of strong hydrochloric acid and of aniline upon mono-brom-cyanethine; the action of chlorine upon cyanethine; the behaviour of phosphorus pentachloride and of fuming hydriodic acid upon the trichlor-oxybase; and the action of iodine upon cyanethine.

Ethylen-diphenyl-sulphon and Ethylen-dipara-tolyl-sulphon.—R. Otto and H. Damköhler.—This paper does not admit of useful abstraction.

Researches from the Chemical Laboratory of Prof. Alex. Saytzeff at Kasan.—These comprise papers by Al. Albitzky on the β-dipropyl-acrylic acid formed from β-dipropyl-ethylen-lactic acid, and on the refractory power of the hydrocarbon $C_{12}H_{20}$ formed from allyl-dimethyl-carbinol. Further, a memoir by W. Schestakoff, on the composition of the by-product formed in preparing diallyl-carbinol; a memoir by E. Schatzky, on the action of a mixture of iodallyl, iodbutyl, and zinc upon acetone, and a paper by S. Reformatsky on a hydrocarbon C_8H_{14} obtained from allyl-diethyl carbinol.

Justus Liebig's Annalen der Chemie,
Vol. 226, Part 3.

Constitution of Camphoronic Acid.—J. Bredt.—After an examination of the salts of camphoronic acid the author concludes that its 6 atoms of oxygen are present in the form of carboxyles.

Communications from the University Laboratory of Wurzburg.—These consist of a memoir by J. Wislicenus on certain new reactions of dichloric ether; a paper by Karl Ullsch, on the decomposition of chloro-carbonic ester by zinc chloride; a dissertation, by E. J. Jones, on the behaviour of α-methyl-propyl-β-oxy-butyric acid when heated; and a paper by J. Norman Collie on the action of ammonia upon acetacetic-ester.

Communications from the Chemical Institute of the University of Strassburg.—These include, as portions of Professor Fittig's study of the lactones and lactonic acids:—A paper by Moesin Beg Chanloroff on butyrolacton and α-ethyl-butyrolacton; a memoir by Moritz Rühlmann and Rud. Fittig, on the behaviour of vabro-lactone and iso-capro-lactone with water and hydriodic acid; a paper by Gustav Ebert on the behaviour of cumarine, cumarone, and orthocumaric acid with hydrobromic acid and bromine; a memoir by H. Hochsteller on melilotic acid and its anhydride, and one by Bruno Frost on the constitution of the terebic and teraconic acids.

Cosmos les Mondes.
No. 14, December 13, 1884.

This number contains no chemical matter.

Sale of Food and Drugs Act.—Mr. Bernard Dyer, F.C.S., F.I.C., has been appointed Public Analyst for Southend.

MEETINGS FOR THE WEEK

Monday, 19th.—London Institution, 5.
— Medical, 8.30.
— Society of Arts, 8. (Cantor Lectures.) "Climate, and its Relation to Health," by G. V. Poore, M.D.
Tuesday, 20th.—Royal Institution, 3. "Colonial Animals," by Prof. Moseley.
— Pathological, 8.30.
— Institution of Civil Engineers, 8.
Wednesday, 21st.—Society of Arts. 8. "Labour and Wages in the United States," by D. Pidgeon.
— Meteorological, 7. (Anniversary.)
Thursday, 22nd.—London Institution, 5 and 7.
— Royal, 4.30.
— Royal Society Club, 6.30.
— Royal Institution, 3. "The New Chemistry," by Prof. Dewar.
— Society of Arts, 8, (Howard Lectures.) "The Conversion of Heat into Useful Work," by W. Anderson, M. Inst. C.E.
Friday, 23rd.—Royal Institution, 8. "Fauna of the Seashores," by by Professor Moseley, at 9.
— Society of Arts, 8. "The Agricultural Resources of India," by E. C. Buck.
— Quekett Microscopical Club, 8.
Saturday, 24th.—Royal Institution, 3. "Greek Sculpture," by Dr. Waldstein.
— Physical Society, 3. "On a Mode of Exhibiting the Spectra of certain Substancss by Burning them in an Atmosphere of Oxygen," by E. Clemenshaw. "On a Theory concerning the Molecular Architecture of Solids, illustrated by Experiments on the loss of Energy of a Wire Vibrating Torsionally," by Herbert Tomlinson.

THE CHEMICAL NEWS.

Vol. LI. No. 1313.

NOTES ON THE DETECTION OF NITROUS AND NITRIC ACID.

By R. WARINGTON.

Having been occupied for some years in the Rothamsted Laboratory with studying the production of nitrous and nitric acid in various mediums, I have naturally been led to examine the reactions employed for the detection of these two acids, and to make some trials of their respective delicacy. In the case of reactions which have been long in use, the limits of their indications have already been pointed out by more than one chemist. The mode in which a test is applied has, however, so great an influence on its delicacy, that I shall perhaps be pardoned if I include in the present notice even those reactions which are most familiar to chemists.

Detection of Nitrous Acid.

Of the four tests we have to mention under this head it is to be recollected that the last three only are absolute tests for nitrous acid, producing their characteristic reaction with no other body.

1. *The Iodide Test.*—Till within the last few years the only delicate test for nitrous acid with which chemists were acquainted was based upon its reaction with hydriodic acid, in which iodine was liberated and starch coloured blue. This test originated with Dr. A. Price. The reaction is remarkably delicate, but has the disadvantage that the liberation of iodine is determined by many other conditions besides the presence of nitrous acid. Oxidising agents generally give the same reaction as nitrous acid. The iodate not unfrequently present in potassium iodide will produce the reaction. Light also is apparently capable of decomposing hydriodic acid. When using this test it is advisable to make a blank experiment at the same time, all the reagents employed being added, in similar proportions to those adopted in the principal experiment, to a volume of distilled water equal to that of the liquid being tested. Any purple colouration which appears in the blank experiment of course indicates that the result is being influenced by other circumstances besides the original presence of nitrites.

In the experiments I have to mention the iodide test was prepared after the manner recommended by Trommsdorf. 5 grms. of starch and 20 grms. of zinc chloride, with 100 c.c. of water, are boiled together for a long time. 2 grms. of zinc iodide are then added, and the whole diluted to 1 litre. The clear solution obtained by subsidence or filtration is employed. If preserved from light it is very permanent.

The nitrite solutions employed in these and all other experiments were prepared by dissolving weighed quantities of silver nitrite in water, and then [adding a small excess of potassium chloride.

The test experiments were made with 5 c.c. of nitrite solution, placed in small beakers on a sheet of white paper. To the solutions 1 c.c. of Trommsdorf's reagent was added, and one drop of dilute sulphuric acid (1 in 5). When a much smaller proportion of Trommsdorf's reagent was employed the colouration was much delayed. A blank experiment with distilled water was placed by the side of the nitrite solutions.

With a nitrite solution containing 1 part of nitrogen per million of water, the liberation of iodine was immediate and large, the liquid speedily becoming black.

With a solution containing 1 in 10 millions the reaction began in about one minute, and was soon considerable.

With 1 in 20 millions a blue colouration began in two or three minutes.

With a solution containing 1 in 100 millions a blue tinge appeared in half-an-hour, and in three hours became very distinct.

With 1 in 200 millions a faint blue tinge appeared after one hour: the colour very slowly increased, but was always very small.

The blank experiment with distilled water began to colour after four hours.

2. *The Meta-phenylene-diamine Test.*—We owe this excellent test to Dr. Griess. The solution is made in the proportion of 5 grms. to a litre, a little sulphuric acid being added; it is then decolourised by animal charcoal, and preserved from light. Before applying this test to a liquid the latter is first acidified with sulphuric acid. When a considerable amount of nitrite is present the colour produced is a deep orange-red, and the liquid soon becomes turbid from precipitation of the colouring matter. When the proportion of nitrite is but small the colour is a pale straw-yellow. The reaction requires some time for completion, and is retarded by cold. The test experiments were made with 5 c.c. of nitrite solution, placed in narrow test-tubes; two to four drops of the meta-phenylene-diamine solution were added, and one drop of dilute sulphuric acid.

With 1 part of nitrogen as nitrite in 1 million of water a very distinct reaction speedily occurs.

With 1 part in 10 millions a change of colour begins in about two minutes, but the final tint is only a very pale straw. This amount of dilution is about the practical limit of the use of the test.

3. *The Para-amido-benzene-azo-dimethyl-aniline Test.*—This recent addition to the chemist's means of detecting nitrous acid we owe to Mr. R. Meldola. The experiments to be described were made with material kindly supplied by him. The solution was prepared by dissolving 0·16 grm. in a little hydrochloric acid, and diluting to 1 litre. A weaker solution would suffice for delicate testing. When the reagent has been added to the liquid to be tested the whole is acidified with sulphuric acid, and afterwards made alkaline with ammonia. If no nitrous acid be present the tint produced on diluting the reagent is a pale citron-yellow, changed on the addition of acid to rose-pink, and re-converted to citron-yellow by ammonia, or other alkali. If, however, nitrites are present, the rose-pink produced on acidification changes more or less rapidly to a salmon colour, and on the addition of ammonia a fine sapphire-blue is developed. If only a trace of nitrite is present, or the reagent has been used in excess, the colour produced by ammonia is sap-green, from admixture with the yellow of the reagent. If the solution is re-acidified, the blue or green is re-converted to salmon-pink. This reaction is a very elegant one, the succession of colours being very charming to the eye.

The reaction consists of two stages, and ammonia will produce the blue compound only when the nitrous acid has altered the original body. When much nitrite is present the addition of ammonia may follow at once the acidification of the liquid; but if only little nitrite be present, time must be allowed for the first stage of the reaction, and if ammonia is added too soon traces of nitrous acid may escape detection. The first stage of the reaction is greatly assisted by heat. These facts are indicated by the following experiments. In all cases 5 c.c. of the nitrite solution were placed in a narrow test-tube, one drop of the reagent, and one drop of dilute sulphuric acid added, and finally ammonia in slight excess.

With 1 part of nitrogen as nitrite in 100,000 of water, a sapphire-blue colour was developed by ammonia without waiting between the addition of the reagents.

With 1 part in a million of water no reaction was obtained when the reagents were added consecutively without interruption. By allowing five minutes to elapse after acidification before adding the ammonia a faint green was obtained, which was further intensified when ten or fifteen minutes were allowed for the first stage of the reaction; further waiting had little or no influence. If, instead of allowing the acidified solution to stand in the cold, the test-tube was plunged for two minutes into boiling water, and then cooled, the reaction with ammonia was much stronger, a full blue colour being produced.

With a solution containing 1 part of nitrogen as nitrite in 10 millions of water no reaction was produced by ammonia, even when the acidified solution had previously remained nineteen hours in the cold. By heating the acidified solution for two or three minutes, as above described, a distinct blue reaction was obtained on the addition of ammonia.

With a solution containing 1 part in 100 millions, a pale sap-green tint was obtained when the preliminary heating was attended to.

The reaction proposed by Meldola is thus considerably more delicate than that given by meta-phenylene-diamine; it has, however, the slight disadvantage that the blue and green tints produced are not permanent, but fade somewhat rapidly.

4. *The Naphthylamine Test.*—Attention was called by Dr. Griess to this reaction as one of extreme delicacy for the detection of nitrous acid. The liquid to be tested is treated first with sulphanilic acid, then acidified, and a solution of hydrochloride or sulphate of naphthylamine added. If much nitrite is present a deep ruby colour is produced, the solution quickly becoming turbid by precipitation of the colouring matter; if only a trace of nitrite is present, the colour will be pale pink.

Like the reaction previously described, the chemical changes consist of two stages, but as both of these will proceed side by side in an acidified solution, there is no advantage in postponing the addition of the naphthylamine. The reaction is not apparently facilitated by heat. Working in narrow test-tubes as before, and adding one drop of a saturated solution of sulphanilic acid, one drop of dilute hydrochloric acid, and one drop of a saturated solution of naphthylamine hydrochloride, the following results were obtained.*

With a solution containing 1 part of nitrogen as nitrite in 1 million of water, an immediate pink colour was produced, rapidly deepening to a dark ruby tint.

With a solution containing 1 part in 10 millions, a pink tinge was almost immediately produced, deepening gradually to a full rose colour.

With a solution containing 1 part in 100 millions, a pink tinge first became perceptible at the end of six minutes; at the end of an hour the solution was of a distinct pale pink colour.

With a solution containing 1 part in 500 millions no reaction was obtained for an hour or two, but a faint pink tinge was finally developed. In a large volume of solution a distinct pink tinge was obtained with a dilution of 1 in 1000 millions; but this colour was barely perceptible in a three-inch column, unless a test-tube containing pure water was placed by the side for comparison.

The naphthylamine reaction thus exceeds all others in delicacy. The colour produced has the additional advantage of being permanent.

Detection of Nitric and Nitrous Acid.

The four following tests give a reaction both with nitric and nitrous acid. The first-named test gives its reaction with no other bodies, and is thus of peculiar value. The three remaining tests give the same reaction with oxidising agents generally as they do with nitric or nitrous acid.

1. *The Ferrous Sulphate Test.*—This well-known reaction is best performed as follows:—A small quantity of the liquid to be examined is placed in a test-tube, twice its volume of pure oil of vitriol run down the side of the tube, so as to form a layer beneath it; then, a pipette containing 3 c.c. of a cold saturated ferrous sulphate solution being taken in one hand, the contents of the test-tube are suddenly mixed, and the ferrous sulphate at once run in, so as to form a layer on the top of the sulphuric acid. The formation of a dark band between the two layers of liquid indicates the presence of nitric or nitrous acid. In very dilute solutions the band is of a faint pink colour. The reaction is less delicate when the solutions are very cold. Using 1 c.c. of the nitrate or nitrite solution, and 2 c.c. of oil of vitriol, the following results were obtained.

With a solution containing 1 part of nitrogen as nitrate or nitrite in 100,000 of water, an immediate reaction was obtained, a pink band appearing between the two layers of liquid.

With a solution containing 1 part in 200,000 a faint reaction was obtained after one or two minutes.

With a solution containing 1 part in 300,000 the reaction was very small.

No distinct result was obtained with greater dilutions. The reaction with nitrates and nitrites was apparently equal.

2. *The Indigo Test.*—The destruction of indigo-blue is a very delicate test of the presence of oxidising agents; its delicacy depends chiefly on the smallness of the amount of indigo which constitutes a visible blue colour. The test has been chiefly developed by Boussingault. In his method, the substance, concentrated as far as possible, is boiled in a test-tube with a drop or two of indigo solution, and successive additions of strong pure hydrochloric acid: the entire destruction of the indigo, or a change of colour from blue to green, indicates the presence of nitrates, nitrites, or other oxidising matter. I have not succeeded in finding a definite statement of the delicacy of the test as used by Boussingault. One division of his weakest indigo solution is, however, equal to 0·00077 milligrm. of nitrogen as nitric acid. This represents a very small, but quite appreciable, amount of indigo: it is approximately equal to half a drop of the standard indigo solution employed by myself for water analysis (*Trans. Chem. Soc.*, 1879, 578).

Indigo may fail to detect small quantities of nitric acid if sugar, urea, or many other other kinds of organic matter, are present; these bodies are apparently oxidised in preference to the indigo during the prolonged heating necessary for the reaction.

3. *The Brucine Test.*—When a solution containing a distinct amount of nitrate or nitrite is treated with a drop or two of brucine sulphate solution, and then suddenly mixed with a considerable volume of oil of vitriol, a bright pink colour is developed, which more or less quickly disappears, and is replaced by a permanent orange or amber tint. With very weak solutions of nitrate it is difficult to observe the pink stage of the reaction without special precaution. By running the oil of vitriol in without mixing, and then mixing suddenly over a sheet of white paper, a pink flash may be seen to pass through the liquid. If the temperature is kept down during the reaction by standing the beaker in cold water, and adding the oil of vitriol very gradually, the pink colour is more slowly developed, and is much more permanent. This is the most delicate mode of using the test with which I am acquainted. The following experiments were made on 2 c.c. of liquid, 1 drop of brucine sulphate, and 5 c.c. of oil of vitriol being added.

With 1 part of nitrogen as nitrate in 10 millions of water, the materials being cooled during mixture, no immediate reaction took place, but a distinct salmon-pink tinge soon appeared.

With 1 part of nitrogen in 20 millions a faint tinge of pink was produced after some time.

A few trials were made with nitrite solutions. With one containing 1 part of nitrogen in 1 million a full pink colour was obtained. With one containing 1 part in 10 millions it was difficult to obtain a reaction.

As the oxidising effect of nitric acid depends on its concentration, it is probable that still smaller quantities may be detected by evaporating the liquid to dryness, and treating the residue with a crystal of brucine sulphate, and

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* These experiments have been already described in a paper "On the Appearance of Nitrous Acid during the Evaporation of Water," *Trans. Chem. Soc.*, 1881, 229.

next with oil of vitriol. This mode of work has been recommended by Nicholson.

4. *The Diphenylamine Test.*—Of this test I have made considerable use; it is one of great practical value. The material can be easily obtained. The reaction is well marked. The diphenylamine is to be treated with a little water, and then dissolved by the gradual addition of strong sulphuric acid. For delicate experiments the solution is best prepared as required. One or two cubic centimetres of the liquid to be tested are placed in a very small beaker, a drop of the diphenylamine solution added, and then twice the whole volume of pure oil of vitriol. If more than a trace of nitric or nitrous acid be present a purple-blue colour will at once develope, and increase considerably in intensity on standing. The colour is fairly permanent. It is advisable in delicate experiments to make a blank experiment with distilled water to ensure that no colour is produced by the diphenylamine and oil of vitriol.

The proportion of oil of vitriol used has a great effect on the result. A nitrate solution containing 1 part of nitrogen per million will give no reaction if a single volume of oil of vitriol be employed, while a strong reaction is obtained when a double volume is added. In weak solutions the reaction is increased if the oil of vitriol is added so as to produce considerable heat, and diminished when the liquid is cooled during mixture. The presence of a small amount of chloride considerably increases the delicacy of the reaction when the volume of oil of vitriol used does not exceed the volume of the liquid. Thus a nitrate solution containing 1 part of nitrogen per million, which gave no reaction with diphenylamine and its own volume of oil of vitriol, gave an immediate reaction when a little potassium chloride was first added. Chlorides appear rather to diminish the delicacy of the test in very weak solutions when a double volume of oil of vitriol is employed.

The delicacy of the diphenylamine test is not quite so great as would be imagined from the depth of colour produced in a moderately weak solution of nitrate, the oxidising power of the nitric acid apparently diminishing rapidly with its dilution. Thus the depth of colour yielded by a 1 in 10 millions solution is much less than one-tenth of that yielded by a 1 in 1 million solution.

The following test experiments were made on 2 c.c. of liquid, to which 2 drops of diphenylamine solution, and 5 c.c. of oil of vitriol were added.

With a solution containing 1 part of nitrogen as nitrates in 1 million of water, a blue colour was at once produced; the liquid soon became opaque from the intensity of the tint.

With 1 part in 10 millions no immediate reaction took place, but after a few minutes a distinct pale blue gradually developed.

With 1 part in 20 millions no distinct blue colour was observed.*

With a similar series of nitrite solutions very similar results were obtained. The blue colouration appears more speedily with nitrous than with nitric acid.

If only 1 c.c. of liquid is taken for experiment the diphenylamine reaction is capable of distinctly indicating the presence of 0·0001 milligrm. of nitric nitrogen.

Detection of Nitric Acid in the Presence of Nitrous.

The reactions already mentioned as serving to detect nitrous acid,—especially those numbered 2, 3, and 4,—afford a certain means for distinguishing nitrites when mixed with nitrates. The detection of nitrates in the presence of nitrites is not so easy; indeed, I am not at present acquainted with any qualitative reaction for nitric acid which is not shared by nitrous acid.

The problem admits of attack by quantitative experiments. It is possible to determine the quantity of nitrous acid present by titration with permanganate, or by using meta-phenylene-diamine for a colorimetric determination. The total nitric and nitrous nitrogen may also be determined by conversion either into ammonia or into nitric oxide. The amount of nitrogen existing as nitric acid might then be found by the difference between the two determinations. Such a method, though fairly satisfactory when a considerable quantity of nitrate is present, is quite unsuitable for establishing the existence of small quantities, as all the errors of two quantitative experiments affect the result.

The other mode of dealing with the problem is first to destroy the nitrites present, and then to examine the liquid for nitrates. There is much more hope for a satisfactory method arising in this direction, but up to the present time I am not aware of one that really meets the requirements of the chemist.

The simplest mode of destroying nitrites is by means of urea, as proposed by Piccini. If a solution of nitrite is treated with a little urea, then slightly acidified with sulphuric acid, and gently heated, the nitrite is rapidly destroyed, the nitrogen being evolved as gas. I have found that even extremely weak solutions of nitrite lose all their nitrous acid by two minutes' heating in boiling water when treated in this manner. After the treatment with urea is completed it is easy to test the liquid for nitric acid with diphenylamine. This method would meet all the requirements of the case were it not that it is impossible to acidify a nitrite solution in atmospheric air without producing nitric acid. In fact, a small quantity of nitric acid is always found when employing this method, even when pure nitrites are the subject of the experiment. The nitrates formed are proportional to the nitrites previously existing in the solution.

I have made but one trial of another method recommended by M. M. P. Muir for destroying nitrites, namely, conversion into ammonium salts and evaporation to dryness. This method is open to a similar objection to the former, it being impossible to evaporate ammonium salts to dryness in an ordinary way without the mass becoming acid from dissociation, and nitric acid being therefore produced.

A further method recommended by Piccini is based on the fact that nitrites are decomposed when heated with a perfectly neutral solution of ferrous chloride, while nitrates are decomposed only when the ferrous salt is acidified. This reaction appears unsuitable for the detection of really small quantities of nitrates, as, after destroying the nitrites, it seems impossible to apply any ordinary tests for nitric acid. To discover its presence it must either be reduced to ammonia, or liberated as nitric oxide gas.

A solution of the problem seems most hopeful either by conducting the urea reaction in the absence of oxygen, or by the destruction of ammonium nitrite in the constant presence of a large excess of ammonia.

VALUATION OF OAK-BARK AND GALL NUTS.

By FRANZ MUSSET.

This author, like Jean, bases his method of determining tannin on its reaction with iodine. His process is, however, entirely different from that of Jean in the manner of its execution. For standardising the solution of iodine 0·07 to 0·1 grm. of the purest tannin, dried at 100°, are accurately weighed, put in a phial holding 50 to 60 grms., and containing about 20 c.c. of warm water free from air. When dissolved it is mixed with 20 c.c. of a solution of iodine (1 : 10) and the glass is filled so full with warm water, free from air, that the upper strata of the water

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* In the *Transactions of the Chemical Society*, 1884, 644, I have stated that diphenylamine will give a reaction with nitric acid when the solution contains only 1 part of nitrogen in 20 millions. The result there mentioned was obtained with the addition of a chloride: the supposed pure salt has since been found to contain a trace of nitrates. This correction does not affect the statement as to the influence of chlorides made above.

may not mix with the solution of iodine, and the phial is then closed air-tight with a cork. If the air finds access the hydriodic acid formed becomes oxidised and the result is incorrect. After the phial has stood over-night undisturbed the contents are emptied into a beaker, the phial rinsed out with water, and the excess of iodine is titrated back as follows:—Starch paste is added and sodium thiosulphate (hyposulphite) until the mixture is decolourised, and then, immediately, iodine until the blue colour is restored.

For determining the value of oak-bark an average sample of 15 grms. is taken and dried at 100°; of the dry matter 10 grms. are weighed off and covered with water (free from air) in a litre flask up to the neck. The flask is loosely stoppered, placed in the water-bath, and after it has reached the temperature of the bath and the air has escaped, the stopper is fixed securely, and the whole is digested in heat for some hours. It is then let cool down to the normal temperature, filled up to the mark, shaken, and filtered through a filter which must be kept full. In the meantime three phials are placed ready, No. 1 and No. 3 containing 150 c.c. and No. 2 holding 300 c.c. In each of the phials 1 and 3, 100 c.c. bark extract are well mixed by gentle shaking with 20 c.c. decinormal solution of iodine,* then filled up as above described with water free from air, corked up and set aside untouched until used. For filling up the phial No. 2, 4 to 5 grms. of zinc oxide are gently rubbed up with the extract of bark, the mixture is poured in, the phial is filled up with more of the bark extract, and allowed to stand for 24 hours, shaking frequently. The rest of the bark extract is filled into phials each holding 150 c.c. and set aside. After the lapse of 24 hours a small sample from No. 2 is filtered perfectly clear and tested for tannin with glue or ferric acetate. If the former is not precipitated, or if the latter gives no distinct colouration, the entire liquid is filtered through a large, double filter, pouring back the filtrate until it runs through perfectly clear. Of this filtrate, 100 c.c. are put in a phial holding 150 c.c. (which is now called No. 2), 20 c.c. decinormal solution of iodine are added, filled up, and let stand over night well corked. The contents of No. 1 are now emptied into a beaker, rinsed out with water, and disregarding the precipitate mixed with starch-paste, and titrated back with hyposulphite. The decolouration is not readily detected, whence an excess of hyposulphite must be used. In this manner the quantity of iodine combined with the bark extract is ascertained. The contents of No. 2 are similarly treated, showing the quantity of iodine combined with the constituents of oak-bark less the two tannic acids. If the quantity of iodine found in No. 2 is deducted from that given in No. 1 the difference corresponds to the iodine combined with both the tannins.

The precipitate produced in the phial No. 3 is oak-red tannin. It is filtered through a small suction filter under a cover of petroleum ether, washed with 20 c.c. of water freed from air and saturated with iodine, dried at 110° in a current of carbonic acid, and weighed. To the weight are added 0·005 grm., which remain dissolved in the washing-water (the precipitate is insoluble in the mother-liquor; the precipitate contains 7·8 per cent of iodine. The quantity of iodine contained in the precipitate is now calculated, double the quantity—as an equal weight is converted into hydriodic acid—is subtracted from the weight of the iodine combined with both the tannins, when the remainder represents the true tannin alone. This quantity of iodine is calculated into tannin, and we say that an oak-bark contains, *e.g.*, 7·5 per cent of oak-tannin "expressed as tannin." The weight of the oak-red tannin is found by subtracting the proportion of iodine from the weight of the iodised acid and adding an equivalent quantity of hydrogen.

The author considers the determination of the oak-red tannin necessary, as, according to his experience, it has a decidedly tanning action.

The determination of tannin and of gallic acid in nutgalls is effected in a similar manner. Two grms. powdered galls dried at 100° are made up to 1 litre, and phial No. 3 (300 c.c.) is filled with 3 grms. rasped hide† and 300 c.c. extract of galls. In phial No. 1 is determined the totality of the combined iodine; in No. 2 the quantity combined with the non-tannic acids or with the tannin or gallic acid together, and in No 3 the quantity combined with the non-tannic acid + the gallic acid or the tannin.—*Zeitschrift fur Anal. Chemie.*

ON THE CHEMICAL COMPOSITION OF THE CARTILAGE OCCURRING IN CERTAIN INVERTEBRATE ANIMALS.‡

By W. D. HALLIBURTON, M.D., B.Sc. (Lond.),
Sharpey Physiological Scholar, University College, London.

At Professor Lankester's suggestion I have submitted to chemical analysis the cartilages occurring in Sepia and in Limulus.

The basis of the cartilage is a chondrin-like body which gives the reactions of mucin and gelatin; indeed, chondrin, as it occurs in the ordinary hyaline cartilage of vertebrates, is now regarded by many as a mechanical mixture of these two bodies. But in the cartilages of the two invertebrates in question the gelatinous element is exceedingly small, and no gelatinisation occurs on the cooling of the hot watery extract.

In addition to this, however, the cartilage of both these animals differs from that of vertebrates in containing a certain small percentage of chitin. In the case of Limulus 1·01 per cent, and of Sepia 1·22 per cent of chitin in the dry state is present.

I have also demonstrated that chitin exists in the liver of the king crab, though whether in the connective tissue or in the liver cells themselves I cannot say. The connective tissue element is very abundant in the liver of this animal, and it seems probable, looking at the part that chitin plays as a supporting structure in these animals, that it really forms in this instance a partial basis for the connective tissue.

The way in which chitin was demonstrated to exist was the same in all three cases, viz.:—

1. After digesting with potash, a residue insoluble in boiling alkalies remains behind.
2. This residue, which when washed and dried is obtainable in a white amorphous condition, is insoluble in weak acids; but in concentrated mineral acids it is soluble in the cold.
3. On boiling the solution in sulphuric acid, a body which has the power of reducing cupric salts is formed.
4. On boiling the solution in hydrochloric acid it turns brown, and on evaporating this solution to dryness a body crystallises out which has all the properties of hydrochlorate of glycosamine.

I prepared some of this body from the chitin contained in the exoskeleton of cockroaches, and also obtained from Professor Lankester some crystals of the same body which Professor Gamgee had kindly sent him.

I was thus enabled to compare the crystalline body I had obtained from the invertebrate cartilage with that of the pure hydrochlorate of glycosamine, and they were found to agree in the following points:—

a. Crystalline form: rhombic prisms of the monoclinic system; measurement of the angles gave the same result in all cases.
b. Action of polarised light: *nil.*
c. Solubilities: easily soluble in water, soluble with difficulty in alcohol.

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* So as not to occasion froth, which would not subside during the experiment.

† This must previously be washed with boiling water to remove products of decomposition which are mostly present and which may combine with iodine. It is then pressed between folds of filter-paper.

‡ A Paper read before the Royal Society, January 15, 1885.

These results are especially interesting as showing that chitin is not a body which is exclusively epiblastic in origin, but in these three instances at least occurs in mesoblastic structures.

NEW CHEMICAL LABORATORY AT CAMBRIDGE.

The plans for the new chemical laboratory, as designed by Mr. J. J. Stevenson, of Red House, Bayswater Hill, after consultation with Professor Liveing and Professor Dewar, have been approved by the Syndicate, who have issued the following description of the design:—

The proposed new chemical laboratory is designed to stand upon the site of the Perse Almshouses, opposite Pembroke College Lodge, and upon the west side of the the old Botanic Garden. The total length of the frontage from the corner of Free School Lane to the corner of Corn Exchange Street is 516 feet. Of this distance the proposed laboratory will occupy 200 feet, leaving 257 feet between its east end and the present buildings of the School of Human Anatomy.

This site is peculiar, and has entailed some peculiarities in the architectural treatment of the proposed new building. In the first place, there is a bend in the line of the street opposite the Master's Lodge of Pembroke College, which it is impossible to rectify in the new building without a great sacrifice of space, on account of the small depth of ground on which the Perse Almshouses stand. In the next place, it is not possible to put up buildings of more than a very moderate height on the side next Free School Lane without interfering with the ancient lights of the Perse Grammar School. It is proposed, therefore, to occupy this part of the ground with a large lecture room and with a porter's lodge, neither of which need be of a lofty elevation. The principal building is connected with this wing at the point where the bend in the street occurs, and the front of it extends eastward about 100 feet, overlapping the new buildings of Pembroke College on the opposite side of the street to about one-third of their length. A one-storied wing extends from this in a northerly direction towards the mathematical and botanical lecture rooms.

The basement is sunk about five feet below the level of the street. It extends under the whole building, and in it are provided—beneath the lecture room, an unpacking room and two store rooms adjoining; beneath the main building, a large room, for a metallurgical laboratory and a furnace room; adjoining it a room for organic analysis and one for such operations as the heating of substances under pressure, a large room 41 feet by 23 feet, to contain a steam engine, dynamo-electric machines and other machinery, also a lavatory and cloak room. In the rear of the machine room is the boiler room, capable of holding boilers to supply steam for heating the whole building as well as for the steam engine. Underneath the northern wing are two rooms which are to be fixed with uninflamable materials, where such operations as the distillation of ether and other easily ignited substances can be carried on, a small laboratory where a special class of students can work, a store room, a lavatory, and a small chamber with windows all round it, where experiments with such substances as chlorine or bromine can be carried on.

On the ground floor the large lecture room is 40 feet square, and will seat 204 persons on benches rising towards the back. It is 30 feet high to the ceiling. Adjoining the lecture room, and communicating with it behind the lecture table, are the preparation room and the specimen room, which are also provided with independent access to the yard and to the store rooms below, and to a private laboratory and balance room above. These rooms also serve for the use of two smaller lecture rooms which adjoin them on the east side. The lecture room will be connected for the purpose of ventilation, with the general ventilating shaft in the middle of the building, and will be provided with a separate draft chamber for lecture experiments.

The principal entrance to the main building is from Pembroke Street. A rise of 14 steps from the pavement reaches the entrance-hall on the level of the ground floor, whence access is had to the two smaller lecture rooms, each 29 feet by 24 feet, and to the principal range of students' laboratories. The ventilation of the rooms will be provided by means of a ventilating shaft carried to a height of 100 feet, heated in winter by the fires of the steam boilers, or by a separate fire. In one corner of the large laboratory, a small chamber, similar to that in the basement, ventilated by windows all round, will serve for operations with chlorine. The balance room opens through a lobby into the central room and into the advanced students' laboratory. A closet for sulphuretted hydrogen is placed next the ventilating shaft and is ventilated thereby. Lifts place the laboratories in communication with the store rooms below. The floors are of wood. The drains are formed of iron troughs lined with asphalte, carried between the joists beneath the level of the floor, covered with movable boards.

On the first floor are two rooms of the same dimensions as the small lecture rooms on the ground floor, of which one may be used as a professor's laboratory and the other as a class room. These rooms also communicate with the private laboratory above the preparation room. On this floor is also a second range of students' laboratories, consisting of two laboratories and a balance room of the same dimensions as the rooms below, and another private room for a professor. The largest of the rooms on the ground floor is not carried higher, but in the attic over it is a large space which may be utilised for some purposes, and the central part of the roof is flat, so that on it such experiments as are best carried out in the open air can be conducted. In the attic there is a considerable space, of which part may be appropriated to chambers for the assistants, and the rest will be available for making and stowing diagrams for spectroscopic observations, and for other purposes which do not require any special appropriations. It is calculated that the students' laboratories will accommodate 175 students working at one time, and if further extension should be required hereafter it can be attained by putting another floor above the northern one-storied wing. This would provide room for about 75 more.

The architecture has been throughout subordinated to the necessities and convenience of the building. The first requirements of the building are ample light and thorough ventilation, for which the large windows, divided by stone mullions, are very suitable. This form of window has also the advantage that it permits the irregnlar arrangement of the floors necessitated by the plan without breaking up the regularity of the front. To allow the light to reach well into the rooms, the windows are kept square at the top and close to the ceiling, except in the lecture hall, where round arched windows (which, however, give ample light) seem to be demanded by the architecture.

An approximate estimate has been made of the cost of the building, which, including heating apparatus, comes to £22,000. The usual commission for architect and surveyor and clerk of the works' wages would add between £1600 and £1700, and the special fittings and machinery necessary to a laboratory of this size cannot be estimated at less than £7000, making the amount in all £30,700. This sum leaves no margin for contingencies such as an extra foundations, which, from the nature of the site, may possibly be more costly than usual.—*The Times*.

Composition of the Seed of the Cotton Tree.—M. Sacc (*Compt. Rendus*), writing from Cochabamba, describes the composition of the seed of the cotton trees of Bolivia. According to his statement the seed contains 6 per cent of caseine, 23·7 of fibrine, besides starch, sugar, and oil.

ANTHRACENE FROM WATER-GAS TAR.[*]

By ARTHUR H. ELLIOTT, Ph.D., F.C.S.

The presence of aromatic hydrocarbons in the products resulting from the destructive distillation of petroleum and its allies has been proved by quite a number of experimenters. L. Prunier[†] treated the products of the distillation of petroleum with bromine, and found that those coming off at low temperatures did not absorb this element, while the products coming off at higher temperatures readily absorbed it, and contained the aromatic hydrocarbons, anthracene, pyrene, chrysene, fluoranthrene, acetnaphthene, petrocene and carbpetrocene, together with ethylenes and acetylenes.

Liebermann and Burg[‡] found that by passing the heavy oils resulting from petroleum and paraffine refining through red-hot tubes they obtained a mixture of hydrocarbons similar to ordinary coal-tar, and containing four per cent of benzol and toluol with nine-tenths of one per cent of crude anthracene. Petroleum yielded benzol but no anthracene. Salzmann and Wichelhaus[§] obtained similar results.

All these experimenters worked upon the products of destructive distillation carried on in small apparatus in the laboratory. But the tar produced by passing heavy petroleum over wood heated to redness on a large scale, was examined by Letny.[||] After several passages through the red-hot tubes it was found that the tar contained benzol, toluol, xylol, naphthalene, anthracene, phenanthrene, and unchanged petroleum. By passing heavy petroleum through a small tube heated to redness and filled with charcoal Letny obtained amylene, benzol, toluol, xylol, and oils boiling at higher temperatures, but no solid hydrocarbons.

Rudnew[¶] says, that at the Kasan Gas Works the tar resulting from the manufacture of petroleum gas is distilled in the ordinary way. It yields ten to twenty per cent of benzol, and five per cent of naphthalene, together with anthracene; but he does not give the percentage of the latter.

A little more than a year ago I obtained some of the tar formed during the manufacture of so-called water gas. The tar is obtained in that part of the process where a mixture of carbonic oxide and hydrogen containing the vapour of petroleum naphtha is passed through red-hot retorts. This proceeding converts the hydrocarbons of the paraffine series into a mixture of ethelyne, acetylene, and members of the aromatic series. It was already known to me that this tar contained naphthalene in very large quantities, and it appeared most probable that other hydrocarbons of the aromatic series were also present, more especially anthracene. Since anthracene is the most valuable of the higher members of the aromatic hydrocarbons, from its use in the production of alizarine—and the day is not far distant when water-gas will be used more extensively, at least in the United States—the value of water-gas tar for the manufacture of anthracene appeared to me of considerable importance. My first efforts were confined to the distillation of the tar, and an examination of that part of the distillate that comes over at 210° to 350° Celsius. This distillate was dissolved in glacial acetic acid, and gave a clear solution; which was treated with a mixture of chromic acid dissolved in a mixture of acetic acid and water, according to the well-known method of Lück. After digesting some hours, the mixture was poured into water, and a flocculent precipitate separated. This precipitate, having all the appearance of anthraquinone, was thoroughly washed with water, then with dilute solution of sodic hydrate, and finally with water again. The result of this experiment was that that part of the tar distillate coming over between 210° to 350° contained 5·8 per cent of anthracene.

The distillation which gave the above results was continued still further until the contents of the retort became coked. The distillate thus obtained was treated with glacial acetic acid the same as the above; but only 32·7 per cent of it was dissolved. The resulting solution was treated with chromic acid dissolved in acetic acid as described before, and the anthraquinone obtained was equal to 2·08 per cent. of anthracene in the distillate obtained from 350° Celsius to coking.

In the next experiment I took a measured quantity of tar, 340 cubic centimetres, and obtained a small quantity of oil distilling over below 200° Celsius. The distillation was continued until the contents of the retort were thick pitch. This gave a distillate which was a mixture of oil and solid crystalline matter, amounting to 52·9 per cent of the original tar. The oil was carefully poured off from the solid part of the distillate, and the latter was treated with petroleum spirit (boiling-point 65° to 105° C.) The solids thus washed were of a pale yellow colour and equal to 3·97 per cent of the original tar. These solids were dissolved in glacial acetic acid, and treated with chromic acid in the manner before stated. The resulting anthraquinone was equal to 2·90 per cent of anthracene in the original tar.

From these experiments it became evident that this tar was particularly rich in anthracene, and I determined to pursue the experiments still further, but time did not permit until last summer, when I have again made an examination of quite a number of tars from the manufacture of water-gas.

These tars have a specific gravity ranging from 1·080 to 1·100, are liquid at summer temperatures, and more or less solid during the winter.

Taking one of the dense tars the following results were obtained:—The specific gravity was 1·100. For distillation 400 cubic centimetres were taken, and gave the following fractions and weights per hundred volumes of tar distilled:—

Temperature, Degrees Celsius.	Weight of Distillate from 100 volumes.
80 to 200	9·2 {⅓ Oil ⅔ Water.
200 ,, 270	11·2 Solid. 17·7 Oil.
270 ,, Pitch	6·0 Solid. 26·5 Oil.
Last fraction	1·7 Semi-solid. 6·0 Oil.
Total	78·3

The fraction coming over between 80 and 200 degrees consisted of a mixture of oil and water, and was reserved for future examination. The second fraction between 200 and 270 degrees Celsius was filtered, and the oil pressed from the solid part between sheets of filtered paper. The pressed solids were crystalline, and were dissolved in glacial acetic acid, and treated with chromic acid according to the method of Lück. This gave only 0·82 per cent of anthracene, which is equivalent to 0·09 per cent on the original tar. The oil from these pressed solids had a specific gravity of 1·030; it was not examined for anthracene because the pressed solids had given so little of this hydrocarbon. The pressed solids are practically all napthalene, and the oil yields no phenol when treated with alkalies.

The third fraction coming over at 270 degrees to near the end of the distillation was filtered, and the oil pressed

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[*] Paper read at Philadelphia Meeting of the American Association for the Advancement of Science.

[†] *Ann. Chim. Phys.* (5), 17, 5. *Jour. Chem. Soc.* 36, 1025.

[‡] *Berichte deutsch. chem. Ges.*, 1878, 723.

[§] *Berichte deutsch. chem. Ges.*, 1878, 802 and 1431.

[||] *Ding. Jour.*, 229, 353.

[¶] *Ibid.*, 239, 72.

out with filter-paper as in the case of the second fraction. The pressed solids were of a greenish-yellow colour and of low melting-point. They were treated with about four times their weight of petroleum naphtha (boiling-point between 65 and 105 degrees Celsius) to obtain crude anthracene. This crude anthracene had a melting-point of 155° Celsius, and was equal to 18·6 per cent of the pressed solids. By treatment with chromic and acetic acids it was found to contain 85·1 per cent of its weight of pure anthracene, which is equal to 15·83 per cent on the pressed solids. But an examination of the wash petroleum naphtha showed that much anthracene had gone into solution, therefore a direct determination of anthracene in the pressed solids was made, without previous treatment with petroleum naphtha. It was now found that the pressed solids really contained 25·6 per cent of pure anthracene, which is equivalent to 1·54 per cent on the original tar.

The oil from the pressed solids of the distillate coming over above 270° had a specific gravity of 1·080, and by treatment with acetic and chromic acids gave 3·0 per cent of pure anthracene, which is equivalent to 0·79 per cent on the original tar.

The last fraction was obtained only a few minutes before stopping the distillation and when the contents of the retort were in a viscous condition. This fraction was filtered, and the crystalline mass of oil and solids left on the filter were treated with petroleum naphtha; the amount being too small to submit it to pressure with filter-paper. By this treatment the semi-solids gave 2·0 per cent of their weight of crude anthracene, which is equivalent to 0·15 per cent on the original tar. This crude anthracene had a bright orange colour, but was too small to submit to chromic acid treatment. The oil from the last fraction was treated with chromic and acetic acids, and gave 1·81 per cent of its weight of pure anthracene, which is equivalent to 0 11 per cent on the original tar.

The anthraquinone resulting from the treatment with chromic acid had all the properties necessary to its identification. It was of a pure white colour, melted at 272° Celsius, and gave beautifully fine crystalline needles by sublimation, and also by solution in benzol. Analysis gave 80·08 per cent of carbon and 5·14 per cent of hydrogen; theory requiring 80·77 per cent of carbon and 4·76 per cent of hydrogen. This analysis is not as good as it should be, and the small quantity of material at my disposal is the only reason for presenting it. Nevertheless it is sufficiently close to help to identify the anthraquinone in connection with the other properties mentioned and the circumstances of formation.

The total anthracene obtained was equal to 2·63 per cent on the original tar.

Former experimenters on this class of tars have been satisfied to simply detect the presence of anthracene, or, as in the case of Liebermann and Burg, to record the crude anthracene found. These last gentlemen found 0·9 per cent in tar obtained from heavy oils from petroleum refining, and assuming that this crude anthracene contained 50 per cent of pure hydrocarbon, the result is only 0·45 per cent on the tar they used. Ordinary coal tar obtained in the destructive distillation of bituminous coal for gas contains only 0·3 to 0·4 per cent of anthracene, while the tar I have described contains four or five times that amount.

Perhaps the most interesting fact in connection with this water-gas tar is that it is the result of the destructive distillation of light petroleum naphtha. This naphtha consists of those members of the marsh-gas series of hydrocarbons boiling below 150°, and consequently entirely free from the more or less solid paraffines found in the heavy oils used by other experimenters.

As time permits I hope to examine these tars still further, and at some future date will give an account of other constituents.

School of Mines, Columbia College, N.Y.,
September, 1884.

DECOMPOSITION OF POTASSIUM CYANIDE.

By J. F. WILKES.

ENTOMOLOGISTS frequently find it convenient in killing insects to use a bottle containing moistened potassium cyanide over which plaster-of-Paris is spread. The insect usually dies in a few minutes after inclosure in the bottle, the mixture assumes a brownish tint, and the odour of hydrocyanic acid can easily be detected. As no explanation of this reaction could be found, some experiments were undertaken with a view to deciding the effect of the plaster-of-Paris and how far it is necessary for the reaction.

To determine the nature of the gas given off, about one grain of pure potassium cyanide (only the chemically pure was used throughout these experiments) was placed in a test-tube, moistened with water, and covered with a layer of plaster. Through an accurately-fittting cork two bits of tubing entered this test-tube, one extending to the surface of the mixed substances and having its other end connected with a washing flask containing a strong solution of sodium hydroxide; the other just entered the cork and was connected with a calcium chloride tube to which was joined a tube, 300 m.m. long, filled with mercuric oxide. A smaller tube from the end of this dipped beneath a solution of potassium hydroxide. By means of an aspirator, air was drawn through this system of tubes slowly and at regular intervals for about two days. At the end of this time the potassium hydroxide was tested with the ferroso-ferric solution, and no trace of Prussian blue could be detected. The calcium chloride and mercuric oxide tubes were then removed and air once more drawn through into a solution of potassium hydroxide. On testing this the reaction for hydrocyanic acid with the ferroso-ferric solution was very clearly given. Here, then, was proof that hydrocyanic acid and no cyanogen was formed during the reaction. As a confirmatory test, however, hydrochloric acid was added to a portion of the potassium hydroxide through which the gas had been drawn, then sodium hydroxide, and it was heated to boiling. No ammonia could be detected, There was therefore no potassium cyanate present, and hence no cyanogen had entered the liquid.

The aqueous solution of potassium cyanide can be kept unaltered in closed vessels at ordinary temperatures according to Pelouse and Geiger ("Gmelin's Handbook," vii.,415), but when boiled it is resolved into ammonia and potassium formiate. It is well known that a strong smell of ammonia can be detected on opening a bottle containing moist cyanide, but we have seen no mention of the formation of hydrocyanic acid from the cyanide by simple decomposition without the aid of carbon dioxide or any strong acid. It was noticed during these experiments that when moistened potassium cyanide was enclosed in a test-tube and air aspirated over it for several days a slight but distinct Prussian-blue test was given by the solution of potassium hydroxide through which the air after leaving the tube was drawn. Of course every precaution was taken to free the air from all traces of carbon dioxide or acid. It was made to pass through a wash-bottle containing a concentrated solution of sodium dydroxide, then through two U-tubes filled with small lumps of solid hydroxide, and lastly, to have proof of the absence of carbon dioxide, through a small tube containing lime-water, passing thence into the tube contoining the cyanide. This experiment was repeated at various temperatures ranging from 12°—18° C. and always with the same result. If the amount of moisture was small, the depth of colour obtained in the ferroso-ferric test was slight. If about 1 c.c. of water was used to 1 grm. of the cyanide a clear deep green was obtained. With calcium carbonate, ordinary hydrated calcium sulphate, or barium sulphate, the cyanide, when mixed in about equal parts and moistened gave off apparently about the same amount of hydrocyanic acid as when alone, judging from the depth of the colour in the ferroso-ferric test. With the anhydrous sulphate a distinct blue was obtained, showing a decidedly increased decomposition, and in this case the mixture left in the tube had a purplish brown colour which was not observed with the others.

Since other sulphates and other calcium compounds failed to act on the potassium cyanide and no change in the anhydrous sulphate itself could be detected, it seemed probable that its action was due in some way to its power of combining with a portion of the water present to form the hydrated sulphate. When an access of water, 3 to 5 c.c., was added to the mixture of the cyanide and the anhydrous sulphate, the test showed very little, if any, more hydrocyanic acid to be given off than when the hydrated sulphate or the cyanide alone was used and no discolouration was produced. When barely moistened the evolution of hydrocyanic acid was considerable. If porous, partially dehydrated calcium chloride was added to the cyanide in the place of the sulphate, the amount of acid evolved was still greater and the colour of the mixture almost black. Anhydrous sodium carbonate had the same effect, though in a lesser degree. Again, when the cyanide and the plaster had both been carefully dried, the air was drawn over them for four days and no hydrocyanic test could be gotten in the final tube of potassium hydroxide.

The mixture of potassium cyanide and anhydrous calcium sulphate left after two or three days of aspirating was examined and found to contain potassium hydroxide. The reaction then is probably

$$KCN + H_2O = HCN + KOH.$$

It has been shown by Karsten (*Poggendorff's Annalen*, 115, 348) and Storer (*Amer. Chem. Journal*, v., 69) that where air alone comes in contact with corks and organic connectors carbon dioxide is formed. This would probably account for the decomposition when potassium cyanide and water alone were used, but the greatly increased depth of test when plaster-of-Paris is added shows a decided action on the part of that body.—*Journal of the American Chemical Society*.

PROCEEDINGS OF SOCIETIES.

CHEMICAL SOCIETY.

Ordinary Meeting, Thursday, January 15, 1885.

Dr. W. H. Perkin, F.R.S., President, in the Chair.

Certificates were read for the first time in favour of Messrs. Charles M. Blades, Northwich, Cheshire; Julius B. Cohen, Pendleton, Manchester; Adam Gibson, Leven, Fifeshire, N.B.; John B. Hutcheson, The University, Glasgow; William McD. Mackey, Frodingham, Doncaster; George Patterson, Tufnell Park, London; F. W. Simpson, Mill Hill, Derby; Walter Collingwood Williams, Edgbaston, Birmingham.

The following papers were read:—

1. "*On the Atomic Weight of Titanium.*" By Prof. T. E. Thorpe, F.R.S.

The atomic weight of this element was made the subject of investigation so far back as 1823 by Heinrich Rose. In 1829 Rose published a second series of determinations, which were followed in 1847 by the determinations of Pierre, and in 1849 by those of Demoly. These determinations have given values for Ti varying from 47·92 to 56·39. In framing his arrangement of the elements in accordance with the Periodic Law, Mendelejeff adopted the number 48 as the atomic weight of titanium. A number less than 50 was in fact demanded by the law. A redetermination of the atomic weight of this element, therefore, was obviously required, not only to fix its value as a chemical constant, but as affording an excellent test of the validity of Mendelejeff's hypothesis.

The exact determination of the atomic weight of titanium is rendered difficult from the circumstance that comparatively few compounds of this element exist which are wholly suitable for the purpose. The author of the present communication has made use of the tetrachloride and tetrabromide as the bases of his experiments. He has determined the amounts of chlorine and bromine in these compounds, and also the amounts of titanic oxide which they yield by decomposition with water. He has made in all six series of experiments, based upon the following ratios:—

I. .. .. $TiCl_4 : 4Ag$
II. .. .. $TiCl_4 : 4AgCl$
III. .. .. $TiCl_4 : TiO_2$
IV. .. .. $TiBr_4 : 4Ag$
V. .. .. $TiBr_4 : 4AgBr$
VI. .. .. $TiBr_4 : TiO_2$.

The results are as follows:—

Series I. (8 expts.) .. .. .. 48·014
II. (5 ") .. .. .. 48·016
III. (6 ") .. .. .. 47·969
IV. (5 ") .. .. .. 48·031
V. (4 ") .. .. .. 48·057
VI. (3 ") .. .. .. 47·989

The mean of the whole 31 experiments becomes 48·013 the probable error of the series being ±0·021, and the probable error of the result ±0·0085.

This value assumes, with Lothar Meyer and Seubert's, that the most probable ratios of Ag, Cl, Br, O, and H are—

Ag = 6·7456
Cl = 2·21586
Br = 4·99721
O = 1
H = 0·06265

In calculating his results the author has grouped his observations in accordance with the expression—

$$x = \frac{b_1 + b_2 + b_3 + \ldots\ldots + b_n}{a_1 + a_2 + a_3 + \ldots\cdot\ldots + a_n} = \frac{[b]}{[a]}$$

Full details of the mode of preparation of the substances made use of, and of the methods of analysis and manipulation, are given in the paper.

The number 48·01 differs but slightly from that obtained by Rose in the experiments on which he set the greatest weight; it varies, however, by more than two units from the final number adopted by Pierre, viz., 50·25, and which has hitherto been commonly accepted as the most trustworthy value for Ti.

It will be observed, too, that the number 48·01 is in entire accordance with the value required by the Periodic Law; Mendelejeff's prevision thus receives a further experimental confirmation.

Discussion.

Prof. Dewar, referring to the atomic weights adopted by Prof. Thorpe, said that he hesitated whether to accept O = 16 or O = 15·96; in fact, whether or no Marignac's criticism was not after all correct. It was essential, however, that every atomic weight should be determined in a variety of ways—by a variety of methods. With regard to the atomic weights being whole numbers, he felt no longer any doubt, the evidence that there is often a considerable departure being unquestionable, as in the case of magnesium and zinc, and perhaps also of cadmium.

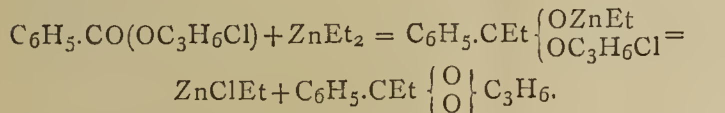
Dr. Gladstone remarked that the fact that there are exceptions does not render it less remarkable that in very many cases the atomic weights are whole numbers.

2. "*Note on the Constitution of Propylene-chlorhydrol.*" By Dr. H. F. Morley and A. J. Green.

It is found that propylene-chlorhydrol, $C_3H_6Cl.OH$, prepared by the action of sulphur chloride on propylene-glycol, yields chloracetone when oxidised either by cold chromic mixture or nitric acid; it therefore consists of the compound $CH_3.CH(OH).CH_2Cl$, with which, perhaps, a small quantity of the isomeride is mixed, as the formation of a small quantity of an aldehyde (possibly chloropropionic aldehyde) was also observed.

3. "*The Action of Zinc Ethide on the Benzoate from Propylene-chlorhydrol*." By the same.

This reaction was investigated in the anticipation that it would be possible to displace the chlorine by ethyl, the benzoate being used in order to protect the hydroxyl of the chlorhydrol. It is found, however, that chemical change occurs in the manner represented by the equations:—



$$C_6H_5.CO(OC_3H_6Cl)+ZnEt_2 = C_6H_5.CEt\left\{\begin{matrix}OZnEt\\OC_3H_6Cl\end{matrix}\right. =$$

$$ZnClEt+C_6H_5.CEt\left\{\begin{matrix}O\\O\end{matrix}\right\}C_3H_6.$$

The benzoate and the new product, *ethylphenylketate*, are described. On oxidation, the latter gives benzoic and acetic acids; it is converted by iodhydric acid into ethylphenylketone and isopropyl iodide; concentrated sulphuric acid has a similar action, the products being the ketone and propylene hydroxide. The authors take occasion to point out that ethylphenylketone is a solid, crystallising in thin plates, which melt at 21°, and not a liquid, as hitherto supposed; it boils at 218° (corr.).

DISCUSSION.

Dr. ARMSTRONG remarked that the action of zinc ethide on the benzoate was, he thought, a normal one, as apparently even in the case of acetic chloride, for example, the oxygen of the carboxyl, and not the chlorine, was first affected. He regretted that the authors had not continued their experiments with the object of settling the question —one of some importance—raised by Markownikoff's and Henry's observations on propylene-chlorhydrol, and that they had not operated with material prepared by the method adopted by these chemists. The comparative study of the chlorhydrol prepared under various conditions, on the one hand, from propylene, and on the other, from its glycol, would probably furnish more valuable information than was to be obtained from the investigation of the ketate described.

Dr. MORLEY in reply said that the ketate was only prepared after a number of futile attempts to determine the constitution of the chlorhydrol in other ways. He also stated that the yield of chloracetone on oxidation was very unsatisfactory. The glycol used was prepared by distilling glycerol with sodium hydroxide.

4. "*On Nitrobenzalmalonic Acids*." By C. M. STUART, M.A.

These acids are prepared by digesting the nitrobenzaldehydes with malonic and acetic acids; that from paranitrobenzaldehyde has already been described to the Society by the author (*Trans.*, 1883, 409).

Orthonitrobenzalmalonic acid crystallises from water in needles melting at 161°, with evolution of carbon dioxide and carbonisation. Analyses of the acid and of its silver and lead salts are given.

Metanitrobenzalmalonic acid melts at 205°, with evolution of carbon dioxide, leaving a residue of metanitrocinnamic acid.

It is noteworthy that whereas benzalmalonic acid and its para- and meta-nitro-derivatives are decomposed on boiling with water, the ortho-acid can be boiled for any length of time with dilute acids without undergoing decomposition.

Ethyl benzylmalonate, cooled by a mixture of ice and chlorhydric acid, is converted by the action of fuming nitric acid into a mixture of the para- and ortho-nitrobenzalmalonate, in which the para-compound preponderates; this is somewhat remarkable, as ethyl cinnamate yields a larger proportion of the orthonitro-derivative.

5. "*Alkaloids of Nux Vomica. III. Some Experiments with Strychnine*." By W. A. SHENSTONE, Lecturer on Chemistry in Clifton College.

In continuation of his experiments on strychnine, the author has studied the action of bromine upon the alkaloid, and also the action of nitric acid on bromostrychnine and upon strychnine itself.

Strychnine can be readily and entirely converted into the monobromostrychnine of Laurent by the addition of bromine to a solution of strychnine hydrochloride in about 50 times its weight of water. The properties of monobromostrychnine are given.

The resinous product obtained by Laurent, which is apt to be the chief product obtained by his method, is found to be a dibromide of the above monobromostrychnine; it has the formula $C_{21}H_{21}BrN_2O_2Br_2$.

By the cautious addition of a solution of bromine in chloroform to a solution of monobromostrychnine in the same liquid, a resinous compound is obtained, which is probably dibromostrychnine.

On treating bromostrychnine, and also strychnine itself, with strong nitric acid, besides the nitrostrychnines of various observers, a fair amount of 1 : 2 : 4 : 6 trinitrophenol is produced. This last observation is of importance, as it shows the presence in strychnine of a benzene-ring of carbon-atoms, and probably also of at least one hydroxyl group, the latter inference being confirmed by the behaviour of strychnine with alkaline oxidising agents.

6. "*On the Physiological Action of Brucine and of Bromostrychnine*." By Dr. T. LAUDER BRUNTON, F.R.S.

The difference between the effect of brucine and strychnine appears rather to be one of degree than of kind, and to be chiefly dependent on the more ready elimination of brucine. Like strychnine, brucine produces death by convulsions and not by paralysis; but like curare, it is innocuous when taken into the stomach, though fatal when injected under the skin. Bromostrychnine has an action very much like that of strychnine.

7. "*Crystallography of Bromostrychnine*." By H. A. MIERS, British Museum.

The crystals belong to the rhombic system, and are mostly rectangular tables. Measurements are given.

8. "*On the Formation of Pyridine Derivatives*." By H. v. PECHMANN and W. WELSH.

It is pointed out that nothing is as yet known of the character of the changes which occur in plants, and which lead to the production of the alkaloids, and that it has not hitherto been possible to produce alkaloids by reactions taking place under ordinary conditions of temperature. In coumalinic acid, discovered by one of the authors, and obtained by treatment of malic acid with sulphuric acid (*Ber.*, 1884, 936), however, a body has been discovered which at once reacts with aqueous ammonia even at the ordinary temperature, forming hydroxynicotinic acid,—

$$C_5H_3O_2.COOH+NH_3=OH_2+C_5H_3N(OH).CO_2H,$$

an acid which stands in close relation to the alkaloids. The method of preparing hydroxynicotinic acid and its properties are described, its constitution is fully discussed, and an account is given of its conversion into chloronicotinic and nicotinic acids. Reference is then made to the action of primary amines on ethereal salts of coumalinic acid. Aniline and the methyl salt give the acid methyl salt of *coumalanilidic acid*, $COOH.C_4H_3(NH.Ph).COOMe$, which is converted by boiling with sodium phenoxynicotinate, $C_5H_5N(OPh).CO_2Na$, a remarkable change, as it involves the "passage of phenyl from nitrogen to oxygen." The same remarkable isomeric change takes place when the product of the action of methylamine on methyl coumalinate is similarly treated, methoxynicotinic acid being formed.

At the next meeting of the Society on Thursday, February 5th, there will be a ballot for Fellows. Professor Frankland, F.R.S., will deliver a lecture "On the Chemical Changes effected by Micro-organism."

UNIVERSITY COLLEGE, LONDON,

Chemical and Physical Society.

Thursday, January 15, 1885.

Dr. R. T. **Plimpton**, Vice-President, in the Chair.

The Secretary read the second part of a paper on "*The Chemistry and Physics of Hot Springs*," in which was described the chemical constituents of the deposits and thermal springs of the Yellowstone Park. They can be divided into two classes—(1) Springs which deposit sulphur and carbonate of lime, which are acid and not periodic; (2) geysers which deposit silica, are periodic, and have neutral or slightly alkaline waters. An analysis of the deposit of the Mammoth Hot Springs showed a percentage of 99·0 per cent of carbonate of lime, and of the deposit from Old Faithful, the most well-known of the geysers, 87·01 of silica. The gases evolved in the neighbourhood of hot springs have a regular sequence, sulphurous acid being amongst those first emitted, sulphuretted hydrogen amongst the latest. An analogy was drawn between the sequence of the gases evolved from the hot spring district with those met with in ascending volcanoes, and in volcanoes at different periods of their activity. Various specimens of the calcareous and siliceous deposits of the Yellowstone National Park, as well as crystals of native sulphur from the same locality, were exhibited.

Mr. D. L. **Howard** described the preparation and properties of sodic nitro-prusside. It is a good reagent for the detection of acetone, creatinin, indol, and strychnine. Crystals of the salt were distributed to the members.

Samuel Rideal, *Hon. Sec.*

ROYAL DUBLIN SOCIETY.

January 19th, 1885.

Dr. **Cameron** in the Chair.

In the Physical and Experimental Science Section, Prof. **Emerson Reynolds** read a "*Note upon Seleno-carbamide, or Selenium Urea.*" The speaker, who, it will be remembered, was the discoverer of thio-carbamide, stated that he had been experimenting upon seleno-carbamide, the analogue of the sulphur compound, but had been forestalled by M. A. Verneuil as regards publication (*Bull. Soc. Chim.*, 41, 599). This last-named chemist had procured the selenio-carbamide by action upon cyanamide by hydrogen selenide. This, also, was the direction in which Prof. Reynolds had been working. He showed a specimen of this body procured in the above manner. It is a white crystalline substance, possessing similar properties to the sulphur-urea. It is very soluble in hot water. Verneuil says that the selenium-urea when heated rapidly melted without decomposition, but when slowly heated decomposed at 200° C. Dr. Reynolds says that with him it seemed able to stand a temperature of 160°, but after that appeared to slowly decompose, owing to the probable presence of moisture.

Profs. **Cameron, Davy,** and **Tichborne** made some remarks in connection with this paper. The first-named gentleman stated that some years ago he had attempted to make this compound by a similar process to that usually adopted with sulphur-urea, but had failed, probably owing to some of the properties of the selenium compound, as pointed out by Dr. Reynolds.

Prof. **Reynolds** also read a note upon "*Schiff's Method for the Distinction of Aldehyds from Ketones.*" This process is based upon a reaction of aldehyds, in which it restores the colour of a solution of magenta after it has been decolourlsed by sulphur dioxide. Ketones do not bring about any change.

Prof. **FitzGerald** read a paper "*On a Model illustrating some Properties of the Ether.*" There was also an exhibition of some scientific appliances, which would be quite familiar to the readers of this journal.

In the Natural Science Section, Prof. **Sollas** read an interesting communication "*On a Means of Approximately Determining the Refraction Indexes of Minerals in Small Fragments.*"

CHEMICAL NOTICES FROM FOREIGN SOURCES.

Note.—All degrees of temperature are Centigrade unless otherwise expressed.

Comptes Rendus Hebdomadaires des Séances, del'Académie des Sciences. Vol. xcix., No. 26, December 29, 1884.

On Selenio-Urea and its Derivatives.—A. Verneuil.—A current of hydrogen selenide is passed into an ethereal solution of cyanamide containing 20 grms. per litre, into which have been previously passed a few bubbles of ammoniacal gas. After some hours the selenio-urea begins to deposit, and when the gaseous current has been kept up for two or three days the cyanamide is completely transformed. The brown product obtained, filtered from the ether, is strongly pressed, and then dissolved in twice its weight of boiling water. A little selenium is precipitated, and the filtrate, if preserved from the light, deposits selenio-urea in colourless needles, which turn rapidly brown if exposed to the light. The yield is almost theoretical. Selenio-urea, $C_2N_2H_4Se_2$, is inodorous, very soluble in hot water, but less so in cold water and in absolute alcohol, and sparingly soluble in ether. At 200° it melts and is decomposed. Its solutions are decomposed by light, with liberation of selenium, especially in presence of alkalies. With the hydracids at common temperatures, and in presence of air, it gives rise to oxygenated condensation products which, hitherto at least, have no known analogues among the derivatives of urea and sulph-urea.

On Solubility in the Oxalic Series.—L. Henry.—The author concludes that in the total series the solubility in water at the ordinary temperature does not vary in a progressive and continuous manner, but is, on the contrary, alternating. There is, in this respect, a radical difference between those terms containing an odd number of atoms of carbon and those containing an even number of atoms of this element. The former are easily soluble in water, whilst the latter are distinguished by their sparing solubility. It is to be remarked that, as we rise in the series, setting out from oxalic acid, the percentage of oxygen contained in the molecule diminishes, while that of carbon increases. As solubility in a given liquid is not an accidental property, but implies a certain analogy in composition between the solvent and the bodies dissolved, we might expect to find the maximum of solubility in water in the case of oxalic acid, and to see it decrease continuously in the higher terms of the series in proportion as they become richer in carbon and poorer in oxygen. These suppositions are strangely at issue with facts. But regularity reappears if we divide the total oxalic series into two partial series, the one, the series of odd terms, that of the easily soluble acids, and the other, the series of even terms, that of the sparingly soluble acids. In each of them, as far as the fact has been ascertained, the solubility diminishes continuously as the molecular weight increases. The author believes that the amides of the oxalic series behave like the acids themselves as regards solubility in water.

Biedermann's Central-Blatt für Agrikultur-Chemie, Vol. xiii., Part 7.

The Prediction of Night-Frosts.—Dr. C. Lang.—The author controverts the popular opinion that the moon disperses the clouds, and thus indirectly contributes to night frost. He lays down the law that night-frosts are only to be feared when the dew-point lies below the freezing-point of water.

New Determinations of Ammonia, Chlorine, and Sulphuric Acid in the Rain-water at Rothamsted.—Lawes, Gilbert and Warington.—From the *Journal of the Royal Agricultural Society.*

Studies on Heavy Soils, with Reference to their Improvement.—Messrs. Heiden, Voigt, Güntz, and Wetzke.—For the first dressing the authors recommend lime. The crop for the first season should be potatoes; for the second, oats; for the third, tares or peas; and for the fourth potatoes again.

Certain Changes of the Sandy Superstratum of the Rimpau Dam Fields in the Course of Time.—Dr. M. Fleischer.—Not suitable for abstraction.

Potatoes and Liming.—Prof. E. Heiden.—The author describes a disease, potato-scab, occasioned by a parasite fungus, *Rizoktonia solani,* and not due, as commonly supposed, to the action of caustic lime upon the surface of the tubers. The disease is most severe in fields dressed with farm-yard manure.

Influence of the Density of Sowing and the Use of Artificial Manures upon the Yield and the Composition of Oats.—O. Beseler and Prof. Maercker.—It appears that when the seed is sown thinly the proportion of small grains is larger than in thickly sown crops.

The Occurrence of the Spores of Moulds and Septic Organisms in Commercial Cattle Foods.—Prof. A. Emmerling.—Earth-nut cakes on treatment with water and exposure to a temperature of 35° was found to contain micrococci, bacteria, bacilli, and occasionally *Leptothrix* and *Cladothrix.* Cotton-seed cake, similarly treated, putrefied rapidly with a more abundant development of bacteria and bacilli. Palm cake showed only in two cases out of ten the presence of bacteria. Cocoa-cake evolved no fungi within twenty-four hours. The author considers that cakes which develop fungi within twenty-four hours and give off an offensive smell are unfit for cattle-food.

Researches on the Influence of Water on the Vegetation and Production of Plants.—Prof. Hellriegel.—A very extensive physiological memoir, not capable of useful abstraction.

The Proportion of Nitrogen to Phosphoric Acid in Seeds.—Prof. Heiden, Drs. Voigt, Guntz, and Wetzke. An exclusive use of phosphoric acid neither increases nor depresses the protein in the seeds. In oats the proportion of phosphoric acid to nitrogen ranges from 1 : 1·20 to 1 : 2·13; and in barley from 1 : 1·44 to 1 : 2·67.

Composition of the Ash of the Grain and Straw of Wheat grown at Rothamsted in Different Seasons, and on Differently Manured Lands.—J. P. Lawes and J. H. Gilbert.—From the Chemical News.

Moniteur Scientifique, Quesneville. Vol. xv., January 1885.

Memoir on the Bleaching of Calico used in Printing, followed by a Study of English Patents relating to the Bleaching of Vegetable Fibres.—A bulky treatise illustrated with upwards of thirty figures.

Lectures on Fermentation.—W. N. Hartley.—The continuation of a course delivered before the Society of Arts.

Industrial Society of Mulhouse.—Session of the Chemical Committee, Nov. 12, 1884.—A note on oxycellulose confirming the results described by M. Georges Witz was deposited in the Archives. The same step was taken with a memoir on the electrolytic formation of persulpho-cyanogen. M. Gaspard Meyer submitted specimens of incombustible paper hangings, accompanied by a report from the Société d'Encouragement. M. Noelting demanded the opening of the sealed papers Nos. 328, 329, 330, 331, and 358, which were then submitted to the examination of the Committee. The contents of Nos. 329 and 358 having been already published by the author, these documents were deposited in the Archives. The Committee demanded the printing of the three other papers which treat of colouring-matters derived from the paramidic phenols, from thio-aniline, di-amido-sulphobenzide, and from the benzide and iso-butyl-aniline. The same author read a paper on the azylines, a note on the direct transformation of the primary amines into mononitro-phenols and an extensive investigation on isomeric xylidines. M. Albert Scheurer exhibited experimentally a discharge on indigo by means of the hypobromites. He then read a note by M. Breuer on topical printing on wool with aniline blue. He pointed out that the addition of ammonia to colours for printing on wool and silk always gives satisfactory results in case of the anilines or analogous colours.

Foreign Patents.—A series of specifications connected with the chemical arts.

Chemical Patents taken in France.—The list for the month of October last.

On Aloes.—From the *Pharmaceutical Journal.*

Cosmos les Mondes. No. 15, December 20, 1884.

Detection of Lead in the Tinning of Utensils, in Enamels, &c.—M. Fordoz carefully cleanses the vessel to remove grease, &c. He then touches any part of the interior with a drop of nitric acid and evaporates any excess of acid by the application of a gentle heat. To the pulverulent spot remaining is applied a drop of a solution of potassium iodide (5 parts of the salt in 100 of water). If lead is present a yellow spot of lead iodide is produced. The stannic acid formed by the action of nitric acid upon pure tin gives no similar spot.

Bulletin de la Société d'Encouragement pour l'Industrie Nationale. 3rd Série. Tome xi., September, 1884.

Contribution to the History of the Discovery of Artificial Soda obtained from Common Salt.—J. B. Dumas.—The only novelty here is contained in a note. It has been discovered that Nicolas Leblanc was not, as commonly supposed, a native of Issoudun, in the Department of Indre, but of Ivry-le-Pré (Cher). The result of this discovery has been that the Council-General of Indre, who were about to erect a statue in his honour, have dropped the project.

Bulletin de la Société Chimique de Paris. Vol. xliii., No. 1, January 5, 1885.

On Phosphorus Trifluoride.—H. Moissan.—The substance of this memoir has been already inserted from the *Comptes Rendus.*

Alcohols derived from the Xylenes.—A. Colsons.—The author prepares the glycols derived from meta-xylene and ortho-xylene by following the method of Grimaux for obtaining para-xylenic glycol. In this manner he has produced ortho-xylenic and meta-xylenic glycols, and compared their fusion-points with those of the para-xylenic derivatives. The preparation of the mono-substituted derivatives is exactly similar.

Reactions of Ferric Oxide upon certain Sulphates at High Temperatures.—M. Scheurer-Kestner.—On heating to white-redness a mixture of two parts calcium sulphate and one part ferric oxide, all the sulphur is expelled. The fused mass remaining in the crucible dissolves in weak acids, which take up all the calcium and small quantities of iron. The sulphur escapes at first in the state of sulphuric anhydride, and afterwards as sulphurous acid.

On the Composition of the Combustion Gases of Iron Pyrites.—M. Scheurer-Kestner.—Already noticed.

MEETINGS FOR THE WEEK

Saturday, 24th.—Physical Society, 3. "On a Mode of Exhibiting the Spectra of certain Substancss by Burning them in an Atmosphere of Oxygen," by E. Clemenshaw. "On a Theory concerning the Molecular Architecture of Solids, illustrated by Experiments on the loss of Energy of a Wire Vibrating Torsionally," by Herbert Tomlinson.

Monday, 26th.—London Institution, 5.
—— Medical, 8.30.
—— Society of Arts, 8. (Cantor Lectures.) "Climate, and its Relation to Health," by G. V. Poore, M.D.

Tuesday, 27th.—Royal Institution, 3. "Colonial Animals," by Prof. Moseley.
—— Institution of Civil Engineers, 8.
—— Royal Medical and Chirurgical, 8.30.
—— Anthropological Institute, 8. (Anniversary.)
—— Society of Arts, 8. "With the British Association to the Canadian North-west," by Stephen Bourne.

Wednesday, 28th.—Society of Arts, 8. "The Influence of Civilisation upon Eyesight," by R. Brudenell Carter, F.R.C S.
—— Geological, 8.

Thursday, 29th.—London Institution, 5 and 7.
—— Royal, 4.30.
—— Royal Institution, 3. "The New Chemistry," by Prof. Dewar.
—— Society of Arts, 8, (Howard Lectures.) "The Conversion of Heat into Useful Work," by W. Anderson, M. Inst. C.E.

Friday, 30th.—Royal Institution, 8. "Works of Living Composers for the Pianoforte," by Prof. Pauer, at 9.

Saturday, 31st.—Royal Institution, 3. "Greek Sculpture," by Dr. Waldstein.

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THE CHEMICAL NEWS.

Vol. LI. No. 1314.

ON SEPARATION BY CAPILLARY ATTRACTION.*

By J. U. LLOYD.

(Query.—" Is there any method whereby a solvent can be perfectly freed from a substance in solution, without evaporating the liquid, precipitating the dissolved matter in an insoluble form, or changing the liquid (as adding alcohol to water) ?"

This question was addressed to several of our foremost scientists, and without any information being furnished as to another known method. In connection with this subject, it is proper to state that for many years it has been known that charcoal will separate certain organic matters from solution ; and, according to the experiments of Mr. Witt (1856), it was shown that 22 per cent of chloride of sodium was taken from a solution of that substance by filtration through 1¾ feet of sand. These facts are related to the experiments which follow, and to which we can find none similar on record. Indeed, quotations from our acknowledged authorities show that the phenomenon herein brought forward has been generally overlooked. We will cite as follows :—

Filtration.—" The mechanical separation of a liquid from the undissolved particles floating in it."—*Ure.*

" The separation of suspended matter is effected on the small scale for laboratory purposes by filtration through porous paper."—*Roscoe and Schorlemmer.*

" The mechanical separation of fluid from solid matters mixed with them. The pores of the paper permit the fluid to pass through ; whilst the solid matter, being prevented, remains behind."—*Galloway.*)

In a former paper we were led to bring forward an experiment, wherein by evaporating a solution of a mixture of the salts ; chloride of sodium and chloride of ammonium, a separation of these substances was effected—one (chloride of sodium) being deposited near the bottom of the evaporating dish ; the other (chloride of ammonium) being mostly deposited at the surface of the liquid, or even above the surface line, by the familiar creeping process. The examination of these deposits demonstrated that the lower part of the lowest deposit was more than half chloride of sodium, while the upper deposit contained but two-thirds of one per cent of chloride of sodium. The question that presents itself is, can solutions of salts separate from each other after being mixed? In continuing this subject, we shall confine ourselves to a phase closely connected with the foregoing experiment. The experiments tabulated herein were made more than a year ago. If we had written this paper before passing to other experiments, doubtless we should have permitted ourselves to theorise more freely regarding the phenomenon than we care to do at present. As it is, we shall present the experiments, and endeavour to reserve our opinions concerning them for a future day.

It may strike some persons that the present paper is entirely irrelevant to the subject of percolation and precipitation ; but if we are permitted to complete this subject, we think that it will be shown that it is intimately connected with certain features that have considerably troubled pharmacists and others.

An unanswered query, once accepted by one of our most prominent members, is directly interested, and the phenomenon presented herein must be considered before that query can be satisfactorily answered.

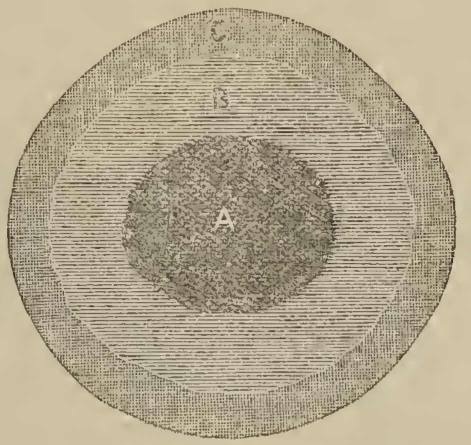
A process of percolation, suggested once, in which the menstruum was directed to be admitted at the bottom of the percolator, and permitted to escape at the top, is also concerned.

Perhaps the analytical chemist will find some food for consideration, as it does not seem unreasonable to suppose that the principle involved in this paper may be of practical value in the separation ot certain bodies one from another. Then, too, it may be found advisable to forego the process of filtration, if possible, where accurate results are desired. However, after we have introduced the line of experiments, and the criticisms into which we have been drawn, these fearures will readily present themselves to those interested.

Let us now revert to the separation of the two salts by the evaporation of the water. The explanation that naturally presents itself is, that their separation resulted from the fact that the chloride of sodium crystallised, and left a mother-liquor of chloride of ammonium. This afterward evaporated ; and thus the salts were deposited in different locations. In order to test the correctness of the view, we were led to several series of experiments ; and a section of one of these may be illustrated as follows.*

Take an ordinary porous blotting-paper, and drop into its centre, drop after drop, some writing fluid. The spot will spread, but it will not present the same appearance from the centre outward. There is usually a dark centre, and then a dark line of demarcation, after which another shade appears, which, after spreading to a certain distance, will perhaps suddenly give place to a nearly colourless liquid. Continue to add the fluid slowly to the centre of the blot, and the shades of colour will expand and preserve their individuality, but the outer will usually grow more rapidly than the one immediately within. Sometimes several shades will be formed, but their individual characteristics will be maintained. If the ink be one of the purple or other colours of aniline, or a carmine, it will be generally found that the outer liquid will be colourless. The striking feature is the abrupt change from one shade to the other. It is not a gradual grading off, for a distinct line of demarcation usually separates each shade. We have introduced this experiment because it can be so readily performed, and because, upon second thought, every person must even now admit its familiarity. Mix two colours of ink, say red and blue, and try the experiment again. Very likely it will be observed that, under the same conditions, one colour will leave the other after both have

Fig. 1.



A, dark purple. B, bright red. C, colourless.

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* Read under the title of " Precipitates in Fluid Extracts," at the Thirty-second Annual Meeting of the American Pharmaceutical Association of Milwaukee.

* We only give enough of the series to demonstrate the one feature to which this paper is devoted. Our investigations have extended far beyond the line drawn by this report, but we do not care to impose upon the Society by introducing another step, as it would double the length of the paper.

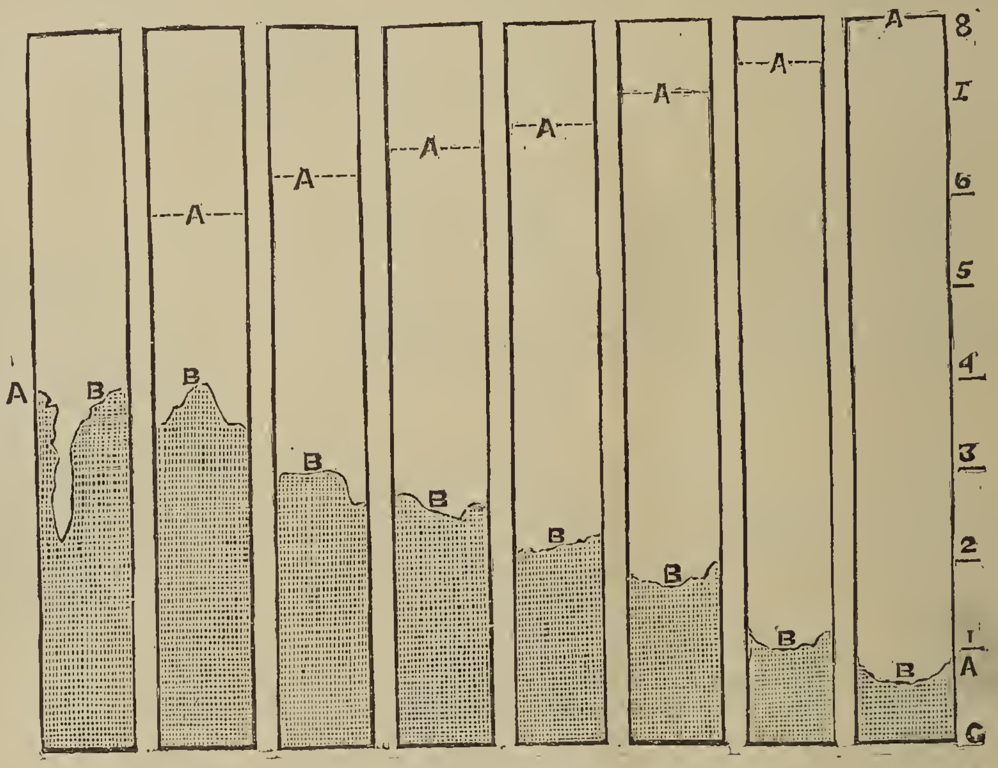
passed together for a certain distance, and leave it completely, and by a distinct line of demarcation. Then, perhaps, this second colour will cease to spread, and a colourless liquid will pass out, and form a ring encircling the ink spot. (Fig. 1.)

These experiments may be easily made, and will illustrate the phenomenon; but since there are so many kinds of ink, it is impossible to predict a certain result. Therefore, to enter into the subject more systematically, we will bring forward the following experiment, in order to illustrate a natural phenomenon that we have not been able to find recorded in any work, and upon which those we have consulted can furnish us no information:—

Dilute one part, by measure, of officinal solution of tersulphate of iron with thirty-two parts of water; then place a strip of blotting-paper, of loose texture, so that the lower end is immersed in the liquid. A liquid is absorbed, and passes rapidly into the paper, reaching to a height of about half an inch at once. Then it ceases to extend upward as solution of tersulphate of iron, but not as a liquid.* A line of demarcation appears as distinct as though drawn by a pencil, and above this line a colourless solution passes; and this liquid is absolutely free from any salt of iron. If a piece of ferrocyanide of potassium be drawn over this paper, it refuses to strike a blue colour until the dividing line is struck. Other reagents demonstrate conclusively the absence of even traces of iron above this line. (Fig. 2—for explanation see Fig. 3). Here we have presented a reaction in which a substance in solution has separated from the solvent, without evaporation of the liquid, apparent precipitation of the solid in insoluble form, or change of solvent power of the liquid.

FIG. 2.

FIG. 3.



A, colourless liquid. B, ferric sulphate. C, surface of liquid. The left hand figure is officinal solution of tersulphate of iron.

In considering this question from the experiment presented, a doubt must arise in our minds regarding the subject. Is it really a separation of a soluble iron salt from a solvent capable of dissolving it? This query naturally occurs when we notice that the upper edge of the iron solution, as it is absorbed by the paper, has a red colour, which deepens as it passes upward, until finally the colourless liquid shoots above it. May it not be that an insoluble basic salt of iron is formed by oxidation of the iron, in the very thin layer of liquid? We thus questioned the matter, and found that the line of division formed as readily and the same in an atmosphere of carbonic acid gas. Again, a piece of paper from just beneath the line—indeed, the very edge of the line of division—when dipped into water, formed a solution that gave a deep blue colour with solution of ferrocyanide of potassium.

This experiment, then, seemed to show that by means of an agency heretofore unrecognised in this manner, and which seems to be capillary attaction, a separation of solvent from substance dissolved can be effected, and absolutely. In analysing the phenomenon, we find that there is not a gradual shading off of iron salt from below upward. It might seem natural to view the reaction as an absorption of the iron by the fibres of the paper through which the liquid passed, until finally all the iron disappeared. Upon the contrary, it seemed to be a struggling upward of several liquids;* and when the so-called solution reaches a certain height, one part of it is attracted onward with greater force, and frees itself from the others. There appears to be an unequal attractive force between the fibres of the paper and the substances passing through them: there seems to be an unequal and independent capillary attraction between the fibres not moistened and the liquids in contact with them. These forces acting at the same time, cause a separation of solutions at a certain distance from the surface of the liquid; and after this separation is once effected the liquid that has freed itself from the other, or others, seems to pass freely through it, or them, apparently drawn from above more rapidly than the other, or others can follow. Thus, although the lower part of the paper is saturated with mixed solutions,†

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[*] The texture of the paper influences the height to which the solution passes before the separation. The line of separation is soonest formed when the paper is porous. Very firm, compact paper will carry the entire solution to a considerable height. Common Swedish filter-paper will answer, but not so well as blotting-paper.

[*] Solution of tersulphate of iron contains other substances besides the salt of iron. There are free acids, and they are not retained in accordance with the detention of the iron. The indications are also that the colouration of solution of ferric sulphate is due to accompanying oxide or oxy-sulphate in soluble form, and that true ferric sulphate has no red colour.

[†] We admit that the term solutions is not in accordance with our present understanding of a solution of several salts in onr menstruum. Authorities do not, we think, view them as distinct liquids mixed together and existing independently of each other, but rather as one solution. For the sake of illustrating these experiments, we shall speak of a solution of different bodies as being an association of separate solutions, each retaining its individuality.

the liquid that has separated itself seems to flow rapidly through the lower stratum and out of the line of demarcation, without a molecule of the iron salt accompanying it.*

In continuing the study of this phenomenon, we find that the proportion which the iron salt bears to the liquid influences the point at which the separation of the iron solution occurs. If the solution is dilute, the separation takes place just above the surface of the liquid in the vessel. As it increases in strength, the iron passes higher upon the paper, and with officinal syrupy solution of tersulphate of iron there will be no separation. (See Fig. 3.)

This fact leads to another point in connection with the subject—to wit, an attraction seemingly exists between the iron salt and the water, which is stronger in proportion to its concentration. Therefore, as the proportion is in favour of the iron, the water has less power to free itself and climb away.

Can it be, then, that capillary or surface attraction has the power to dissociate a solution? If so, it seems to us that this fact must have been overlooked in many instances where its consideration was a necessity to accuracy in results.

In looking at the phenomenon as presented in the foregoing portion of our paper, it will be seen that we may sum up the matter as follows:—

1st. The bibulous paper absorbs and carries to a certain height the liquid about as it exists in the vessel.

2nd. At a point above the surface of the liquid, determined by the texture of the paper and the concentration of the solution, the iron salt ceases to pass upward† as rapidly as the water or other substances held in solution by the water.

3rd. Then the liquids separate, and the colourless liquid is actually drawn (or thrust) through the solution of iron without carrying a trace of ferric sulphate beyond the line of division.

In order to determine the amount of water thus passing through a liquid, we call attention to the following experiment:—

A piece of blotting-paper was placed with the lower end in a solution of ferric sulphate, made by mixing 1 part of officinal solution of tersulphate of iron with 32 parts of water. The separation occurred as previously described, and when the watery liquid reached the top of the paper (5 inches), the iron solution had ascended but 2 inches. The paper was then divided at the line of separation and at the surface of the liquid, the iron solution in the lower part was weighed with the paper, and the water and paper in the upper portion weighed. Each part was then dried, and weighed again.

Result.—Water in the part of the paper that contained iron, 7 parts.

Water in the paper above the line to which the iron had ascended, 7½ parts.

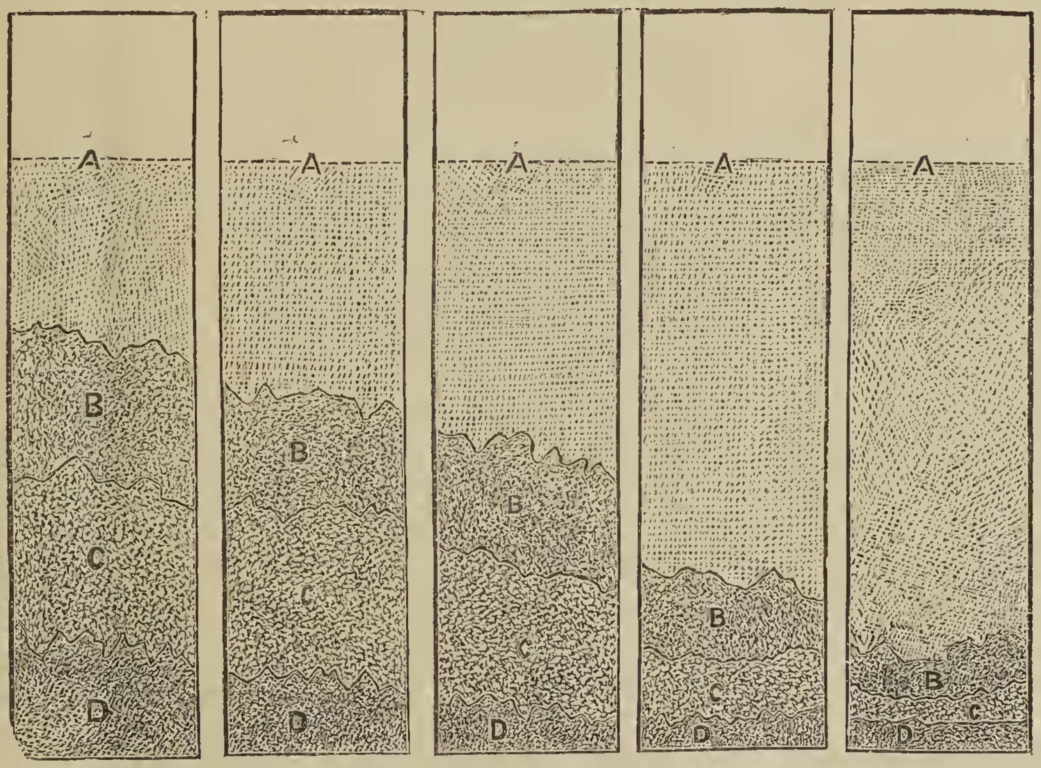
In the same way, one part of solution of tersulphate of iron (ferric sulphate) was mixed with 64 parts of water, and the portions of paper examined.

Result.—Water in the part of the paper that contained iron, 4 parts.

Water above the line to which the iron ascended, 9½ parts.

Fig. 4.

Fig. 5.



A, height of colourless liquid. B, height to which the ferrous sulphate is carried. C, height to which the sulphate of copper is carried. D, height to which the ferric sulphate is carried.

Thus it will be seen that in the first experiment the water that had separated was slightly greater than that remaining with the iron; while in the second experiment more than twice as much water escaped as remained with the iron.

We present also an experiment with acetate of lead, as follows:—

Five grains of acetate of lead were dissolved in one fluid ounce of water. The paper was immersed, and the dividing line ascertained by means of a crystal of iodide of potassium. Upon separating the paper, it was found that—

The water in the part of paper that contained lead amounted to 8½ parts.

Water in the paper above the line to which the lead ascended amounted to 4½ parts.

In the same way, 5 grains of acetate of lead were dissolved in 4 fluid ounces of water:—

The water in the part of the paper that contained lead amounted to 5½ parts.

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* There is a gradual and uniform upward motion of all the liquids, however, although the lowest stratum in the paper moves slowest.

† We use the term upward to correspond with this line of experiments. The same phenomenon is presented when the paper is horizontal or inclined, if capillary attraction only carries the liquid outward.

Water in the paper above the line to which the lead ascended amounted to 13½ parts.

All of these experiments uphold the principle that the weaker the solution the quicker the separation, and the larger the amount of the escaped water.

We have mentioned the fact that mixed coloured inks separate from each other under the influence of the capillary attraction of bibulous paper. It is demonstrated that certain salts will also do this, and completely. In order to show that they act independently of each other when dissolved in a single solvent, we call attention to the followig experiment:—

Dissolve separately, each in 1 oz. of water, 5 grs. of ferrous sulphate (and add one drop of sulphuric acid), 5 grs. of cupric sulphate, and 30 minims of officinal solution of tersulphate of iron (ferric sulphate). Place a strip of bibulous paper upright in each, and it will be found that at a certain height the metallic solution is retarded. This can be readily shown by drawing a piece of red or yellow prussiate of potash down the paper, for the characteristic colouration will appear as soon as the reagent comes in contact with the salt. However, it will be found that they separate at different heights in the papers.

Now mix the solutions, and repeat the paper experiment. When the reagents are applied to the paper, it will be shown that the ferric sulphate extends only a certain distance; then a mixture of ferrous sulphate and cupric sulphate; then the ferrous sulphate alone; and finally a colourless solution passes onward, perfectly free from either salt. (Fig. 4—for explanation see Fig. 5.) The boundary line between each salt is clear and sharp.

Upon diluting this mixture with its bulk of water, the rule of the diluted ferric sulphate (Fig. 3) is found to be maintained; and, by repeated dilution of each succeeding solution with its bulk of water, a series of regular demarcations are obtained, as shown by Fig. 5.

In the same manner solutions of certain alkaloidal salts can be separated from each other, as, for example, sulphate of quinine and sulphate of berberine, the quinine salt passing onward and leaving the berberine.*

In carrying this series of experiments further, it is readily shown that not only can we separate liquids from each other within the paper, but we can separate them as liquids by acknowledging the fact that a liquid tends to flow from a tube, capillary or otherwise, if the extremity is beneath the surface of the liquid in the container. Two test-tubes were placed beside each other, and into one an inch of solution of ferric sulphate (the strength before named) was poured. A strip of blotting-paper was then so placed that one end reached into the liquid, while the other end rested below it in the other vial. The paper was curved so that the height was four inches; therefore the liquid traversed eight inches. The exposed part of the paper was covered by means of a sheet of rubber, in order to retard evaporation. (See Fig. 6.)

In twenty-four hours a layer of colourless liquid was carried into the empty vial, and this liquid refused to show a trace of iron by the usual reagents.

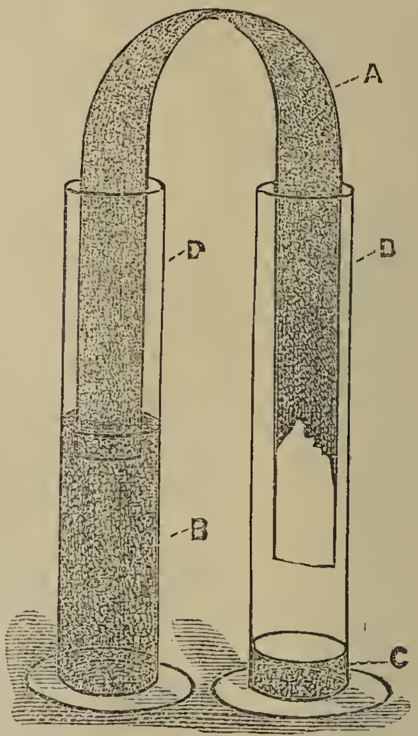
Therefore, to sum up from the view presented by these experiments:

The solvent can be perfectly separated from dissolved matter by what appears to be simply capillary attraction.

We must not, however, infer that this is evidence that such a rule will be carried out with other bodies. Experiments with many salts and other substances agreed, but some refused to separate, chloride of sodium being carried to a height of six feet.

We do not design in this paper to enter into a theoretical argument regarding the causes for the phenomenon herein presented. We aim simply to present the facts, and, in so doing, must consider briefly certain objections that have occurred to us regarding the idea that real solutions can be separated from each other by means of the capillary or surface attraction of materials that have no recognised chemical affinity for either of the constituents. Therefore, as the substances that we have named are all solids, it might perhaps be inferred that the molecules of these solids are held in the minute interstices of the paper, while the more mobile fluid escapes.* Such a view could scarcely be sustained, because mixtures of *liquids* may be separated from each other—indeed, even though such a mixture is supposed to have combined chemically. Sulphuric acid and water are accepted as having rather an intense affinity, and their union is broken only by a considerable display of energy. The mixture of sulphuric acid and water is as perfectly disintegrated by the bibulous paper as were the other substances named by us. This can be shown by making a dilute solution of sulphuric acid in water, and allowing it to pass up the paper, and then pressing a piece of blue litmus-paper upon the surface of the part of the bibulous paper that is moistened. The litmus will change to red for a certain distance, defined by a line of demarcation as distinct as that shown by the iron salt.

Fig. 6.



A, blotting paper. B, solution ferric sulphate. G, transmitted liquid. D, ferric sulphate in paper.

The facts, then, to be presented in this paper are, that—

1st. Liquids can be separated from solids held in solution, without evaporating the liquid or precipitating the solid in an insoluble condition.

2nd. Liquids can be separated from each other.

3rd. Certain chemical combinations even can be broken without calling upon such recognised dissociating powers as high or low temperature, or the action of reagents.

This dissociating force has been overlooked in many places where, perhaps, it might have been useful. It may have been an unknown factor in leading to discrepancies in delicate analytical work that involved frequent filtration. There are other points of interest that we hope to consider in the future.—*Am. Journ. Pharm.*

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* It is not unreasonable to suppose that advantage may be taken of this principle to separate certain bodies that seem to dissolve and precipitate alike. Indeed, we have used it in separating uncrystallisable colouring matters from crystals of organic bodies, where simply the close wrapping of two or three layers of blotting-paper over the moist magma will remove the colouring material as the mass dries out.

* It must be admitted that such a view is not in accordance with our idea of a solution.

GRAPHITE, OR BLACK-LEAD CRUCIBLES.

By J. C. BOOTH, Ph.D.

The use of graphite for pencils, stove blacking, lubricating surfaces, &c., is extremely limited, compared with its enormous value and consumption in crucibles, employed in melting gold, silver, copper, brass, bronze, German silver, &c., and especially in smelting the finest steel for tools, for the tyres of locomotive driving wheels, and even for the ponderous shafts of the great ocean steamers ; in short, wherever the finest quality of steel is demanded in the arts. Such steel being a marked expression of the physical power of civilisation, the chief means of procuring the black-lead crucible has the strongest claim on our attention.

In studying its manufacture I shall successively consider —1, the materials employed ; 2, their preparation and mixture ; 3, the formation and completion of the crucible.

Materials—A black-lead crucible is essentially composed of graphite or black-lead grouud to fine scales, which are rigidly held in their position by partially melted clay ground up with powdered graphite and a little sand, the last being added to prevent shrinkage while drying, and the dried crucible, made from this mixture, is finished by burning at a high heat.

Since black-lead is virtually pure carbon, the question arises why might not the cheapest form of carbon, anthracite, be substituted for it ? Because of the difference in their mechanical structure and their behaviour to heat.

All the forms of carbon combine with the oxygen of the air at a high heat, and gradually burn away into carbonic acid or oxide, but graphite burns much more slowly than any other form (except the diamond). All the forms except graphite, at a strong heat below combustion, crackle into a fine, structureless powder. or are easily ground into powder, the particles of which have no property or means of cohesion, nor of adhesion to other bodies, and cannot therefore be made into a tough coherent crucible.

Black-lead has an eminently laminated, crystalline structure, breaking into thin scales, but not at right angles to their plane, for, however thin a piece may appear to the eye, it breaks into still thinner scales, of the same structure and toughness as the original. A single thin scale held in a delicate forceps shows a remarkable degree of elasticity, when bent, by springing back to its original position unaltered. Neither a low heat nor a white heat will make it exfoliate.

It appears, then, that the distinctive properties of graphite for crucibles are, that it retains the flat or scaley form, even under hard grinding, and at the highest heats ; that the scales are extremely elastic and tough, and that it resists combustion in the air much more than the ordinary forms of carbon.

Varieties of Graphite.—It occurs in three forms, the elastic laminated, the elastic fibrous, and the more amorphous variety. As the elastic fibrous variety may be used indifferently with the scaley, and is quite rare, we need not dwell upon it. I have termed the third form *more* amorphous, because it sometimes has the external appearance of the scaley variety, and does often contain some of it. A little experience will enable one to distinguish it by the eye, and a simple test will establish a more reliable estimate of value. A minute quantity, finely ground in a mortar, will approximately show the proportionate quantity of scaley and shapeless powder, and the conclusion may be strengthened by sifting it through a piece of fine muslin, when the eye can sufficiently determine the relative quantity of each. Since the amorphous variety, although deceptively crystalline in appearance, adds but little, if anything, to the strength of a crucible, the manufacturer should avoid its use as much as practicable. I think that my experience will bear me out in saying, that only at an enormous reduction in relative price, and even then only a small proportion of it compared with the best scaley kind, will warrant the manufacturer of black-lead crucibles in employing it, at the great risk of his reputation, for the best black-lead crucible.

Commercial graphite occurs as "lump-lead," "grains" and "dust." During some years' experience in making black-lead crucibles, I found that by far the greater part of the graphite of commerce consisted of the excellent scaley variety, whether in lump or grains, and therefore giving no pretext for using inferior graphite, except the unsoundness of false economy. I found a barrrel entirely filled by one piece of the best Ceylon graphite, and single lumps of several pounds weight each are of frequent occurrence and of the best quality. A few smaller lumps, up to half-pound weight, are of the deceptive amorphous variety, which is, however, more often present in the fine powder with an iron black, lustreless appearance. Graphite in clean, sifted grains, free from powder, is generally of excellent quality. The best variety has a silvery lustre, the next lower grade, although it may be of fair quality, has a bright, steel lustre, and the lower the grade the more it puts on an iron black, or sometimes a brownish tint.

I have found the impurity of ground commercial lump lead of the best quality to be abcut 6 per cent, and to consist chiefly of quartz and iron pyrites. On the other hand, I have seen silvery graphite in grains of the uniform size of about $\frac{1}{8}$ inch, and without dust, which was almost absolutely pure carbon.

Localities.—Graphite is abundantly distributed in metamorphic rocks, but rarely in large masses together. Many localities have been explored with a view to its use for crucibles, but almost all were successively abandoned, because of the excessive cost of extraction, and in a few cases because of its inferior quality.

The island of Ceylon contributes the great mass of black-lead to commerce ; 14,000 tons having been shipped from it in 1883. Most fortunate is it that nearly all of it is of the best quality.

We find small quantities of it sparingly distributed in all the States of the Union and in every country on the globe where metamorphic influences have imparted a crystalline structure to the lower geological formations. It has been extracted at several different times from the locality in Philadelphia, Penn., within ten miles of the centre of the city, and with partial success. The quality is good, but lacks mass *in loco*.

When called upon to explore the locality, I took the bearing of the adjacent gneiss, &c., and, applying it to the shaft which struck the graphite, I found it pointed exactly to the various openings from which the latter had been extracted. The rocks in contact with and containing graphite, are so highly metamorphosed and confused with crystallisation, that the planes of stratification are only recognisable by experience. Since the rocks are stratified, they were once deposited sands and clays, with the remains of plants that grew on them, condensed and modified into coal, which probably passed through the changes of lignite, bituminous coal, and anthracite into graphite.—*Journal of the American Chemical Society.*

NEW METHOD FOR THE SEPARATION OF COPPER FROM CADMIUM.

By P. GUCCI.

In many laboratories the attempt has been made to substitute less poisonous agents for potassium cyanide as proposed for separating copper and cadmium by Fresenius and Haidlen. For this purpose Stromeyer recommended ammonium carbonate ; Rivot, potassium sulphocyanide ; and A. W. Hofmann, dilute sulphuric acid.

The author proposes another method, which has been used with success in the laboratory of Professor

Barbaglia at the University of Pisa, and which is found to be convenient and expeditious.

To the liquid, from which bismuth has been removed by an excess of ammonia, and which still contains copper and cadmium, there is added hydrochloric, nitric, or sulphuric acid until the hydroxides of both metals are redissolved. A solution (10 per cent) of ammonium benzoate is then added in slight excess, whereby copper benzoate is precipitated. The cadmium is then best detected by means of ammonia and ammonium sulphide. By using a slight excess of ammonium benzoate the separation of the two metals is effected so completely that this method may be advantageously used in quantitative analysis.

The precipitate, collected on a tared filter and washed, is dried and ignited in a platinum or porcelain crucible. The reduced copper is oxidised with nitric acid, then ignited, and weighed. The cadmium is determined in the filtrate.

This method gives accurate results even in cases where very little cadmium occurs along with much copper. —*Berichte der Deutschen Chemischen Gesellschaft.*

DETERMINATION OF NITRIC ACID.

By H. WILFARTH.

The author has obtained unsatisfactory results by the use of Bœhmer's process (*Zeit. Anal. Chem.*, xxii., 20). He believes that to render this method accurate hydrogen must be substituted for carbon dioxide, since the latter gas dissolves in the chromic acid mixture, and air has to be passed through the apparatus for several hours before it can be expelled and a constant weight obtained. He has not, however, made experiments for the improvement of Bœhmer's process, but proposes instead another method, by which he has rapidly obtained accurate results in the determination of soda-saltpetre. This process depends on the conversion of the nitric oxide into nitric acid, which is then determined acidimetrically. The conversion is effected in an alkaline solution by means of hydrogen peroxide.

In performing the operation a quantity of the substance corresponding to about 0·5 grm. of saltpetre is introduced into the decomposition vessel of Bœhmer's apparatus. The gas evolved is passed through two test-tubes, the first containing 10 c.c. of a solution containing 20 per cent of soda crystals, and the second 10 c.c. of a solution of soda-lye of known strength. The contents of both tubes are well boiled, and carbonic acid, freed from atmospheric air, is passed through the apparatus until an absorption experiment with potash-lye shows that all atmospheric air has been expelled. There is then connected to the parts already described an absorption apparatus constructed as follows:—

The nitric oxide gas evolved in the decomposition vessel, after being washed, is passed into a flask holding 250 c.c. This flask is closed with a cork having two perforations. Through one of these enters the tube introducing the nitric oxide. It descends to near the level of the liquid, where it is bent first up and then down again, a small bulb being blown on the ascending limb. A drop of water here can thus prevent diffusion against the gaseous current. Through the other opening in the cork passes a tube which only descends a very short distance into the flask, and turning at right angles serves to connect the flask with a nitrogen bulb-tube holding about 150 c.c., and placed horizontally, with its pear-shaped bulb nearest the flask. The flask is charged with 20 c.c. of hydrogen peroxide—the acidity of which is accurately determined—and 20 c.c. of standardised soda-lye. The two liquids are mixed, and about one-third of the liquid is sucked into the bulb-tube. The arrangement must be so that the nitric oxide gas merely sweeps over the surface of the liquids. If the gas is allowed to bubble through the alkaline solution of hydrogen peroxide the decomposition becomes too rapid. The last residue only of the gas is compelled to pass through the liquid, so as to keep back any traces of acid. The decomposition vessel is then filled through its funnel with 20 to 30 c.c. of a strong solution of ferrous chloride and 60 c.c. hydrochloric acid of sp. gr. 1·124. It is then heated to near ebullition, and the current of carbonic acid is stopped. When the liberation of nitric oxide begins the heat is reduced so that the decomposition may proceed gradually and equably. The duration of the process, from the beginning of the escape of gas until the liquid becomes clear should be twenty to thirty minutes. When the liberation of nitric oxide has almost ceased carbonic acid is again passed through the apparatus until all nitric oxide has been expelled. The boiling must still be continued for some time after the liquid has taken the colour of pure ferric chloride. When the operation is complete the contents of the bulb-tube are rinsed back into the flask, supersaturated with sulphuric acid, allowed to stand for some minutes, boiled to expel carbonic acid, cooled down to the temperature of the room, and titrated back with soda. It is necessary to cool, as the indicator (a solution of litmus containing glycerin) is destroyed in heat by the residual hydrogen peroxide.—*Zeitschrift für Analytische Chemie.*

ACTION OF BORIC ACID UPON CERTAIN COLOURED REAGENTS.

By A. JOLY.

The colouring-matters known as *helianthine*, *tropæoline O O*, or *orangé* No. 3 of the firm Poirrier and Co., undergo no change of colour when mixed with a solution of boric acid, dilute or concentrated, either at ordinary temperatures or at ebullition. Boric acid, further, does not act upon the colouring-matter as an alkali would do, for it is merely needful to add a trace of hydrochloric acid to a strong solution of boric acid, tinged yellow by a few drops of the coloured reagent to turn it abruptly to a red.

It is easy to ascertain, by means of this property of boric acid, that in a solution of borax, however dilute, the boric acid is liberated from one equivalent of soda by means of one equivalent of hydrochloric, sulphuric, or nitric acid. If we pour a standard solution of one of these acids into a solution containing a known weight of borax, coloured yellow by a few drops of a very dilute solution of orange No. 3, we find that the colour turns to a red when the soda contained in the solution is saturated by an equivalent weight of the reacting acid.

Hence it results that a solution of borax behaves with the strong acids in presence of orangé like the solution of an alkali or of an alkaline carbonate, and a solution of borax can be titrated like an alkaline liquid; the substitution of orangé No. 3 for litmus enables this operation to be effected with precision.

Inversely a solution of borax may be employed for the titration of muriatic, nitric, or sulphuric acid, and it presents this advantage as compared with solutions of soda, ammonia, or baryta—that the standard is absolutely permanent, and the glass vessels are not attacked. But borax is sparingly soluble in water, and its solutions act always like weak alkaline liquids. But the change of colour is so well-marked that the use of dilute solutions of borax presents no inconvenience.

Such solutions are standardised by comparison with normal sulphuric acid. The author, however, has obtained solutions of a perfectly accurate standard by dissolving in water a known weight of prismatic borax, purified by several crystallisations, and obtained finally in small crystals, which are dried by expression, and finally by exposure to the air for several days.

An alkaline earthy base, such as lime, combined with boric acid, is likewise totally displaced by an equivalent weight of a strong acid. Suppose we dissolve in a known volume of standard hydrochloric acid, a given weight of an alkaline-earthy borate, redden this liquor with a few drops of the coloured reagent, and add a solution of standard ammonia until the colour turns to a pale yellow. At this moment the hydrochloric acid not combined with the lime is neutralised, and from a comparison of the volumes of the two solutions employed, the alkali and the acid, it will be easy to find the weight of the base contained in the dissolved salt. If the borate is anhydrous, and if it has been previously ascertained to contain nothing save lime and hydrochloric acid, the weight of the latter is found from the difference.

Although this method of analysis only enables us to find the proportion of boric acid as difference, it may, nevertheless render much service for verifying the composition of alkaline or alkaline-earthy borates.

Phenol phthaleine, which is turned so distinctly to a red by strong bases in presence of strong acids, and even of acetic acid, cannot be used for the titration of solutions of boric acid. If we pour the alkaline solution drop by drop into an acid liquid containing phenol phthaleine, we find that the liquid soon takes a light violet tint, which darkens slowly.—*Comptes Rendus.*

LONDON WATER SUPPLY.

Report on the Composition and Quality of Daily Samples of the Water Supplied to London for the Month ending December 31st, 1884.

By WILLIAM CROOKES, F.R.S.
WILLIAM ODLING, M.B., F.R.S., F.R.C.P.,
Professor of Chemistry at the University of Oxford.
and C. MEYMOTT TIDY, M.B., F.C.S.,
Professor of Chemistry and of Forensic Medicine at the London Hospital; Medical Officer of Health for Islington.

To Colonel Sir Francis Bolton, *Water Examiner, Metropolis Water Act*, 1871.

London, January 10th, 1885.

Sir,—We submit herewith the results of our analyses of the 174 samples of water collected by us during the past month, at the several places and on the several days indicated, from the mains of the seven London Water Companies taking their supply from the Thames and Lea.

In Table I. we have recorded the analyses in detail of samples, one taken daily from December 1st to December 31st inclusive. The purity of the water, in respect of organic matter, has been determined by the Oxygen and the Combustion processes; and the results of our analyses by these methods are stated in Columns XIV. to XVIII.

We have recorded in Table II. the tint of the several samples of water, as determined by the colour-meter described in a previous report.

In Table III. we have recorded the oxygen required to oxidise the organic matter, and the quantities of free oxygen present in the whole of the samples submitted to analysis.

Of the 174 samples, all except four, two of which were recorded as "*slightly turbid*," and two as "*very slightly turbid*," were found to be perfectly clear, bright, and well-filtered.

Notwithstanding the considerable and occasionally heavy rain-fall of the month, the quality of the water supplied by all the Companies, in respect to the smallness of the proportion of organic matter present, has continued good, and has not varied appreciably from that taken note of in September and November. The degree of freedom from tint of brownish colour, however, has not been so marked during December as in the preceding less rainy months.

During the past six months we have examined 1073 samples of water drawn from the mains of the seven companies taking their supply from the Thames and the Lea, and have been able to register 1062 of these samples, or just 99 per cent of the whole, as being clear, bright, and efficiently filtered.

Of the 148 samples of water submitted to full analysis—or one sample daily, exclusive of Sundays and holidays—43 samples were furnished by the New River and East London Companies, in chief measure from the Lea; while the remaining 105 samples were furnished by the five Companies taking their supply from the Thames. As regards the quantities of organic carbon—and, consequently, of organic matter—present in these 105 Thames-derived samples, the mean result was 0·132 part, and the maximum result in any one sample, 0·186 part in 100,000 parts of the water, this maximum proportion of organic carbon corresponding to the presence of a little over three-tenths of a grain of organic matter in a gallon of the water. The mean result of the previous half-year was 0·130 part, giving an average for the year 1884 of 0·131 part of organic carbon in 100,000 parts of the water, as against an average of 0·143 part for the year 1883, of 0·160 part for the year 1882, and of 0·180 part for the year 1881; these results showing, accordingly, a successive gradual yearly diminution in the small proportion of organic matter present in the Thames-derived water supply.

We are, Sir,
Your obedient Servants,
William Crookes,
William Odling,
C. Meymott Tidy.

SOLUTION OF SUBACETATE OF LEAD AS A TEST FOR OLIVE OIL.

By S. S. BRADFORD, Ph.G.

When cotton-seed oil is mixed with solution of subacetate of lead a peculiar red colour is always produced. I have called attention to this peculiar colour action and gave it as a test for the detection of this oil when mixed with olive oil as an adulterant. The red colour produced by the solution is, I am fully convinced, peculiar to this oil, as I have been unable after experimenting with the different seed and animal oils for over ten years to obtain it from any other. This alone would cause it to be a valuable test, but not only cotton-seed but any other oil can easily be detected by its use.

Solution of subacetate of lead possesses the peculiar property of saponifying at once when shaken in the cold with pure olive oil. Now if the sample tested contains any cotton-seed or other oil, saponification will not take place no matter how long it is allowed to stand, or how well it may be shaken; if there is any cotton-seed oil in the sample the red colour will always be produced.

The want of a reliable test for olive oil has long been felt, and I offer this one after a series of experiments with all the different oils covering a period of over ten years, fully convinced that in this test we have one that can safely be relied on.—*Am. Journ. Pharm.*

PROCEEDINGS OF SOCIETIES.

PHYSICAL SOCIETY.

January 24th, 1885.

Prof. Guthrie, President, in the Chair.

Messrs. J. Rose Innes, A. Howard, and A. M. Worthington were elected Members of the Society.

Some Lecture Experiments on Spectrum Analysis were shown by Mr. E. Clemenshaw. The chief point in these experiments was the production of a brilliant light without the use of the electric arc. A small quantity of a solution of the salt to be experimented on is put into a flask in which hydrogen is being evolved by the action of zinc upon dilute sulphuric or hydrochloric acid. The bottle is provided with three necks, one being fitted with an acid funnel, one with a jet, and by the other is introduced a current of coal-gas, or, better, of hydrogen, by which the size of the flame can be increased and regulated. The jet, which is about one-eighth of inch in diameter, is surrounded by a larger tube, by which oxygen is admitted to the flame, the result being a brilliant light giving the spectrum of the substance, which is carried over mechanically by evolved hydrogen. The spectra of sodium, lithium, and strontium were shown upon the screen, and the absorption of the sodium light by a Bunsen flame containing sodium was clearly seen.

"*An Instrument to Illustrate the Condition of Equilibrium of Three Forces Acting at a Point,*" was exhibited by Mr. Walter Baily. This instrument consists of a circular disc of soft wood, from the back of which an axle projects. The disc is provided with a graduated circle, and its centre marked by the intersection of two fine lines upon a small mirror. Three compound threads, each consisting of two threads connected by a short piece of elastic, are knotted together, the free end of each being fastened to a pin. Two of these pins are stuck into the disc at such a distance from the centre that the knotted ends cannot reach the centre without stretching each thread, and the remaining pin is then adjusted so that this condition is fulfilled. There are now three forces in equilibrium acting at the knot. The angles between their directions are obtained from the readings of the graduated circle where it is crossed by the threads. To determine the magnitude of these forces, the axle of the disc is held horizontally and turned till a thread is vertical. The pin is then removed, a scale-pan attached to the end of the thread, and weights added till the knot is brought back to the centre. This is repeated with the other threads. It was found possible to show the proportionality of the forces to the sines of the opposite angles with an error not exceeding one per cent.

Mr. C. H. Hinton read a paper "*On the Poiograph.*" As the result of a process of metaphysical reasoning, Mr. Hinton has come to the conclusion that relations holding about "number" should be extended to space. Starting from the premises that the relations of numbers to numbers are numbers,—*e.g.*, the "relation" of 6 to 2 is 3—the author proceeds to carry these principles into the considerations of space, and concludes that when properly understood, the relation of a shape to a shape is a shape, and that of a space to a space is a space. The shape that shows the relation of a shape to a shape is called a "poiograph." To form a poiograph, the content of each shape is neglected, and the shape is represented by a point, each point being by its co-ordinates representative of the properties of the shape considered. The resultant shape is a "poiograph."

MANCHESTER LITERARY AND PHILOSOPHICAL SOCIETY.

Ordinary Meeting, December 16th, 1884.

Charles Bailey, F.L.S., in the Chair.

Mr. E. P. Quinn exhibited several forms of frictional electrical machines.

"*Some Novel Phenomena of Chemical Action attending the Efflux from a Capillary Tube,*" by R. S. Dale, B.A.

The results obtained in the experiments I propose to describe were the outcome of a desire to know what, if any, mechanical action took place where two solutions capable of forming a precipitate were slowly mixed. Next to find the nature of such mechanical action, and latterly, if possible, to measure it. I have made no attempt in the latter direction, but propose describing a series of experiments which have yielded some very novel effects.

1. Solutions of lead acetate and potassium dichromate were allowed to travel in opposite directions along a thread placed in the field of a microscope. At the moment of mixing very considerable disturbance took place, accompanied with a whirling motion. This method not offering results which could be easily registered, it occurred to me to cause one solution to flow into the other through a capillary tube or syphon. The apparatus used was of the simplest possible description, consisting of a pair of cylinders connected by a capillary syphon, the effluent end of which was bent upwards. One cylinder was raised slightly above the other to insure a flow. I have a photograph of the general arrangement adopted.

2. Solutions of lead acetate and potassium dichromate were allowed to mix in this manner. The latter salt was passed into the former. The capillary syphon was charged with water, and after this had passed through the heavier fluid, a series of vortex rings began to be formed at the point of the tube. Later, one attached itself to the tube, and others to this, until a tube was built up *through which* the potassium dichromate was passed without any chemical action taking place to the top of the lead acetate. This action continued until the system reached an equilibrium. Fearing that I could not show the experiments before the Society I photographed some of them, and they show exceedingly well the curious growths of lead chromate which were thus produced. With these two substances to obtain a single tube was most difficult, and only a series could be obtained with anything like certainty.

An experiment was made reversing the fluids. The same results were obtained, though the growth was less stable, as the potassium dichromate, being of much smaller specific gravity, no support was given to the lead chromate formed, and thus the growth continually fell off the point of the syphon.

3. A cold saturated solution of sodium sulphate was passed into a saturated solution of barium chloride. A perfectly straight tube was obtained, which formed with great rapidity, and was very stable. This result was most unlooked for, taking into consideration the great density of barium sulphate.

4. A solution of ammonium oxalate was passed into a solution of calcium chloride. These particular solutions were chosen because the amorphous calcium oxalate first produced on mixing these solutions rapidly becomes crystalline, and the effect could not be surmised on mixing with a capillary tube. The usual phenomena took place until the tube reached the height of about one inch, when the amorphous calcium oxalate suddenly changed to the crystalline variety, and apparently stopped the action, as no further upward growth took place. On careful examination, however, of the point of the growth, a fluid was noticed to emerge which had no action on the surrounding calcium chloride, showing that chemical action was still going on. Now, the upward growth having ceased, it was inevitable that the tube should become wider, and this is what really took place. On another experiment I obtained a nearly spherical body, about half an inch in diameter.

5. Action of ammonia on ferrous sulphate.—A very thick tube of ferrous oxide was formed, which I am able to show you, as it is by no means fragile. It has of course been since, out of the fluid, partially converted into ferrous oxide.

6. Sodium carbonate on copper sulphate.—In this case a crystalline copper carbonate was obtained of two shades, one a bright blue, resembling azurite (if it be not actually that substance), and another a bright green, resembling malachite. I am able to show this tube.

7. Ammonium sulphide on copper sulphate.—An action closely resembling, in many particulars, the action of ammonia on ferrous sulphate.

8. Sodium carbonate on calcium chloride.—The commencement of the action was marked by the formation of

a perfectly transparent and highly refractive sheath of calcium carbonate, which did not show any signs of crystallisation until about half an inch in length. On examination after the lapse of about twelve hours, a crystalline tube of calcium carbonate had made its way to the top of the containing cylinder. This tube was composed of minute but well-defined crystals. I found it impossible to retain it in its perfect shape for inspection here.

9. Sodium carbonate on barium chloride.—A very similar action to that mentioned in experiment 7, but at no time was a transparent substance noted, the growth being quite opaque and not palpably crystalline.

10. Hydrochloric acid on sodium silicate.—Here a well-marked action took place, and a tube of silica was produced, a portion of which I am able to show.

11. Knowing the silica produced by the action of ammonium chloride on sodium silicate was much denser than that obtained in the previous experiment, I caused these substances to act on each other, and succeeded in obtaining a very long tube of silica of considerable thickness. I am able to show this also.

12. Ferricyanide of potassium on ferrous sulphate.—Notwithstanding the extreme lightness of the blue precipitate produced by these solutions a perfect tube was obtained, which reached the surface of the ferrous sulphate.

Many experiments on the above lines will readily suggest themselves, but I think I have described sufficient to call attention to this, to me, novel method of experiment, and I must leave it to some future occasion to describe such others as may show any peculiarities worth noting. I purposely refrain from making any theoretical deductions, with the one exception, that it is pretty certain that these phenomena are inseparably connected with vortex action, the tubes being undoubtedly built up of a series of vortex rings.

NOTICES OF BOOKS.

A Treatise on the Principles of Chemistry. By M. M. Pattison Muir, M.A., F.R.S.E. Cambridge: The University Press.

A work like the present has been for a long time a desideratum in our chemical literature. Daubeny's treatise on the Atomic Theory is completely out of date, and since his time no one has come forward to gather up recent speculations into a coherent totality, and to place before us the philosophy of chemistry as far as such a task is yet possible.

The author complains in his preface that the "chemical student is too often subjected to a shower-bath of facts." Now such a shower-bath, even if unmixed with pseudo-facts, is not science. To give a vital cohesion to the details found in our text-books is therefore his task in the present volume. He well remarks:—"When chemistry is regarded from the point of view of the great workers therein it wears an aspect very different from that with which it confronts the mere text-book taster."

The work before us is naturally divided into two parts, devoted respectively to the statical and the kinetic phase of the subject. The first part is occupied with the discussion of the atomic and molecular theory and its applications to allotropy, isomerism, and the classification of elements and compounds. In the second part we come to consider dissociation, chemical change and equilibrium, affinity, and the "relations between chemical action and the distribution of the energy of the changing system."

In the Introduction the author reminds us that in chemistry our knowledge of composition is much more developed than that of action. Hence, although the study of kinetics might naturally seem to precede that of statics, he is justified in discussing first the latter phase of the subject.

The first chapter considers "atoms and molecules" from a historical point of view, expounding the gradual development of these conceptions as now held and distinguished by the vast majority of living chemists. We come next to Atomic and Molecular Systems. Here the author first examines "nascent action,"—an expression which he considers as having been "at once helpful and hurtful in the progress of chemistry." In concluding this enquiry he holds that "a study of the reactions in which nascent bodies play important parts appears to me to keep before the student that all-important distinction between the atom and the molecule which is so vital in chemical considerations, and also to draw attention in a marked way to the complexity of all chemical changes." If the expression "nascent action" does in any way help to emphasise such considerations as these he thinks it ought to be retained in chemical nomenclature,—a view from which we are not inclined to dissent.

Next follows a comparison between the dualistic and the unitary theories. It is remarkable that just when the reaction against dualism was being led to triumph by three French *savants*, Auguste Comte, aspiring to be the legislator of modern science, could re-assert the fundamental notion of dualism. It is here pointed out that the new or unitary chemistry did not, and could not, refuse to recognise the conception of compound radicles. The suggestive question is here raised: Are these compound radicles really definite groups of atoms always existing as such in compound molecules, or are they only convenient methods of expressing and generalising reactions?

The third section of this chapter treats of the equivalency of atoms. Here we find the following important passage:—"The theory of units of affinity, or valencies, or bonds has been carried too far. It appears at first sight to give a dynamical explanation of the structure of molecules, but it has forgotten the two-sidedness of atomic transactions; it apparently affords a means of measuring atomic forces, but it has used a unit, undefined except as a quantity changeable at pleasure; it appears to simplify chemical formulæ, but it has really made them harder to understand by grafting on to the definite conception of atom the vague and unnecessary notion of 'bond.' When the molecule has been analysed and shown to be an atomic structure, the theory of bonds has attempted to re-construct the building, not by putting together the parts into which it had been seperated, but by the use of new and untried material called 'bonds,' the properties of which—if it has any—are unknown." These strictures are based on the criticisms of Lossen, to which we must refer the reader, and which are continued in an appendix to the section on allotropy and isomerism.

In the fifth section, "molecular compounds," so-called, are taken into consideration, the author showing that a strict definition of molecular, as opposed to atomic, compounds is impossible.

The third chapter consists of an elaborate exposition of the periodic law with its latest developments.

A chapter on the "Application of Physical Methods to the Problems of Chemical Statics" completes the first book. Here, under the section on thermal methods, we find an appreciation of the researches of Berthelot and Thomsen. The results of these investigations are given in detail. The conclusion reached as to their value is not absolutely favourable. The author—justly in our opinion—remarks that if the fundamental distinction between atom and molecule is clearly grasped, it will be seen that Berthelot's *law of maximum work* is too general to be of much service in explaining the mechanism of chemical change. It is simply a crude expression of the principle of the degradation of energy, and does not attempt to analyse the expression *chemical affinity*. "Berthelot's work is saturated with the conceptions of the molecular theory: but by some fatal perverseness he refuses to apply this theory to chemical phenomena. While recognising the existence of molecules, and building his generalisations upon a molecular foundation, he refuses to accept the conception of atom, or rather he hopelessly confuses it with that of equivalent."

"If by chemical affinity is meant an action and reaction between atoms, then the principle certainly does not afford a measure of this affinity." This section requires and will repay a very careful perusal.

The second book, devoted to Chemical Kinetics, embraces an examination of dissociation, of chemical change and equilibrium; of affinity, especially according to the researches of Guldberg, Waage, and Ostwald; of thermal and other methods of studying affinity; and of certain further applications of kinetical methods.

We find here in a note the sketch of a novel and interesting classification of chemical compounds. The author distinguishes—

1. Compounds, the properties of which are not quite the mean of those of their constituents, but which are easily separated into definite constituents, *e.g.*, sulphuryl dibromide. The gases evolved by heating such compounds are only mixtures; the compounds are not re-formed on cooling these gases; under special conditions, chiefly of temperature and pressure, the gases do combine, but the combinations are very unstable.
2. Compounds which can be obtained pure only with much difficulty, if at all, because their properties are connected with the existence of groups of molecules (or groups of atomic aggregates), the composition of which groups varies within certain limits. As soon as attempts are made to remove "impurities" these groups become unstable and undergo re-arrangement. The vapourisation of such compounds will show distinct analogies with the process of dissociation, but the gas obtained will probably consist of one kind of molecules only. The terpenes may possibly belong to this group.
3. Compounds which dissociate when heated. The gas evolved from one of these compounds is a mixture of atomic aggregates, which, on cooling, re-combine to produce the original compound.
4. Compounds which do not dissociate but remain unchanged when in the gaseous state, up to a comparatively high temperature, at which true decomposition begins.

In his final summary the author declares—"I have tried always to exhibit the hypotheses of chemistry as at once arising from facts and serving as guides in the quest for facts. It is especially necessary to do this, I think, in dealing with the questions concerning structural formulæ. If these formulæ are dissociated from the chemical facts which they symbolise they become intellectual tyrants; if each formula is considered simply as a summary of facts regarding the compound formulated, they are to be classed with the other 'brute beasts of the intellectual domain,' and cease to have much interest for one who believes that chemistry is a branch of science."

We cannot too warmly recommend this work to advanced students, be they young or old. They will find it a safe guide to an understanding of the fundamental principles of the science.

The Assay and Analysis of Iron and Steel, Iron Ores, and Fuel. By Thomas Bayley. London: E. and F. N. Spon.

We have here a compact and very useful manual of an important and well-marked department of analytical chemistry. Iron ores, slags, and fuel form, with iron and steel, a class of bodies of the utmost importance. In the metallurgy of iron it is necessary to keep a careful eye both on the raw materials, the auxiliary agents, the intermediate and the finished products. Many of the impurities which are liable to be present interfere seriously with the results, even though their proportion might seem trifling. From the vast scale on which the metallurgy of iron is now conducted minute errors in analysis become multiplied to formidable totals. Hence the necessity for a work like the present, which gives a summary of the methods which have been found to work satisfactorily. The author does not undertake the illusive task of instructing every man to be his own analyst. He supposes that his readers are acquainted with chemical laws and chemical manipulations.

The treatise is divided into three parts. The first, devoted to iron, steel, and ferro-manganese, treats of the preparation of reagents, the determination of manganese, phosphorus, silicon, sulphur, and graphite; of tungsten, carbon, chromium, titanium, of slag, oxygen, and nitrogen, and gives a selection of recent analyses of irons and steels selected for important uses.

In the second part, which discusses ores and slags, we have instructions for the determination of iron, the treatment of insoluble samples, and the determination of ferrous oxide; the determination of moisture, combined water, and carbonic acid, of silica, titanic and phosphoric acids, sulphur, and of the bases.

Thirdly, we have the examination of fuels, including the determination of moisture, ash, sulphur, coke, and volatile matter, the heating power of fuel, the analysis of blast-furnace gases. Lastly, comes a table for the analysis of iron ores, and a set of factors useful in calculations.

CORRESPONDENCE.

IRON SULPHATE AS A MANURE.

To the Editor of the Chemical News.

Sir,—Concerning my recent researches on this subject, the details of which are given in my paper in the present number (January) of the *Journal of the Chemical Society*, I may say, for the benefit of numerous enquirers, the way I have used the manure is in the crystalline condition it comes into the market, and *not* in powder or solution. I prefer to scatter it as a "top-dressing," but it can with advantage be drilled along with the seed with good results.

At the suggestion of Prof. Gustav Bischof, F.C.S., I intend to determine how long after manuring a soil with ferrous sulphate any ferrous sulphate can be detected in the soil.

Prof. Bischof suggests "*that this compound may in the main be active indirectly*;" and Prof. W. A. Shenstone, F.C.S., of Clifton College, Bristol, writes that "*the extra amount of iron which accompanies the use of iron sulphate appears in the results of your interesting work to displace particularly potassium and chlorine.*"

I have numerous problems yet to investigate in connection with this important subject, and I may inform chemists that it will occupy my attention for two or three years to come to place the value of $FeSO_4$ as a manure on the firmest basis.

I wish here to tender my best thanks to Prof. Bischof, Dr. F. T. Bond, M.D., F.R.S.E., Prof. Shenstone, and others (who have kindly written me on the subject) for their suggestions.—I am, &c.,

Dr. A. B. Griffiths, F.C.S. (Lond. and Paris),
Lecturer on Chemistry and Physics, Technical College, Manchester; Silver and Bronze Medallist in Chemistry and Botany.

Thermo-chemical Researches on Phosphorus Fluoride.—M. Berthelot.—The author establishes the presence of a stable fluo-phosphorus acid and probably that of an analogous fluo-phosphoric compound. The existence of these prevents the determination of phosphorus in presence of a fluoride of ordinary methods, even when hydrofluoric acid is first expelled by evaporation along with sulphuric acid.—*Comptes Rendus.*

CHEMICAL NOTICES FROM FOREIGN SOURCES.

Note.—All degrees of temperature are Centigrade unless otherwise expressed.

Comptes Rendus Hebdomadaires des Séances, del'Académie des Sciences. Vol. c., No. 1, January 5, 1885.

Chemical Study of the Skeleton of Plants.—MM. E. Fremy and Urbain.—Cutose, the substance which covers and protects the aërial organs of plants, approaches the fatty bodies in its properties and composition, though distinct from them in certain other respects. Cutose resists the action of energetic acids; it is insoluble in dilute alkalies; neutral solvents have no action upon it, but it is modified by oxidising agents and boiling alkaline liquids. With nitric acid it yields at first resinous bodies, and afterwards suberic acid. Alkalies, and even alkaline carbonates, at a boiling heat dissolve cutose, split it up and convert it into a kind of soap, soluble in water and insoluble both in excess of alkali and in saline solutions. Baryta, strontia, and lime effect the same decomposition. Under the influence of bases cutose gives rise to two new fatty acids, the stereocutic and the oleocutic. The former acid differs from all known solid fatty acids. It is white, fusible at 76°, almost insoluble in cold alcohol and ethers, scarcely soluble in boiling alcohol. Its true solvents are benzol and glacial acetic acid. On boiling this acid with dilute alkalies we obtain gelatinous salts insoluble in water. These two acids, when once modified, acquire new properties, which approximate them much to the primitive cutose. They form a neutral substance, which on treatment with caustic alkalies experiences a kind of saponification.

A Hydrate of Chloroform.—G. Chancel and F. Parmentier.—Chloroform hydrate is obtained in the form of colourless laminæ, resembling the crystals of potassium chlorate, sometimes taking the form of a regular hexagon. Their density lies between that of liquid chloroform and that of the solution of chloroform in water. The hydrate melts at 1·6°, and its composition is expressed by the formula $CHCl_3,18H_2O$.

Laws of Solution.—H. Le Chatelier.—A mathematical paper which does not admit of useful abstraction.

Determination of certain Atomic Weights.—J. D. van der Plaats.—For carbon the author obtained in six experiments values ranging from 12·0010 to 12·0045, the mean being 12·0028. For phosphorus two series of experiments yielded respectively the atomic weights 30·99 and 30·96. For tin the author found in seven experiments a minimum of 118·01 and a maximum of 118·14, the mean being 118·07. For zinc he obtains a mean atomic weight of 65·17. The author remarks that the relation O : H is still uncertain by about 1-200th.

The Saturation of Phosphoric Acid by Bases.—A. Joly.

On Oxygenated Water.—M. Hanriot.—The author prepares oxygenated water at between 6 and 8 vols. by the reaction of hydrofluoric acid upon barium peroxide, which has been first carefully washed with water to remove salts. This oxygenated water is then mixed with baryta water until its reaction becomes distinctly alkaline. Peroxide of barium is thrown down, as well as any iron or manganic oxide which may be present. The filtrate is then neutralised with sulphuric acid, and concentrated in the water-bath to 12 to 15 volumes. It is submitted then to four or five successive congelations to bring it up to 70 or 80 vols., and the concentration is then completed in a dry vacuum.

Fusibility in the Oxalic Series.—L. Henry.—The author confines his attention to the first five terms of the series oxalic acid, and its four next higher homologues up to adipic acid inclusive. In the even series, the oxalic, succinic, and adipic acids, and also in the odd series, the malonic and pyro-tartaric, each term differs from its neighbour by two methyl groups; and in each series this difference of composition involves a difference in fusibility of approximately 32°.

Combustion-heat of some Substances of the Fatty Series.—W. Louguinine.—The substances examined by the author are acetal, mesityl oxide, crotonic aldehyd, and isobutyric acid.

Vol. c., No. 2, January 12, 1885.

The Action of Boric Acid upon certain Coloured Reagents.—A. Joly.—(See page 56.)

Hydrates of Chromium Sesquichloride.—M. L. Godefroy.—The author distinguishes three hydrates:—$Cr_2Cl_6+20H_2O$ forms brilliant green crystalline needles, exceedingly hygroscopic. If placed under a bell over sulphuric acid they lose 8 mols. water, and are converted into the second hydrate, $Cr_2Cl_6+12H_2O$, which forms green scales. The third hydrate, $Cr_2Cl_6+8H_2O$, is a pale green powder. All these are readily soluble in water, alcohol, and ethyl acetate. The solution is of a fine decided green, free from dichroism.

The Alkaline Ferrocyanides, and their Combinations with Ammonium Hydrochlorate.—A. Etard and G. Bémont.—The formation of iron and of potassium cyanide on igniting potassium ferrocyanide has only been exceptionally noted in the reactions of industrial chemistry. Ordinarily it is supposed in error that carbon, iron carbide, and even iron oxide, are the products of such calcination. Ammoniacal salts, and especially ammonium hydrochlorate, yield numerous derivatives with potassium ferrocyanide, several of which have been analysed by the authors.

A Combination of Acetic Ether and Calcium Chloride.—J. Allain-le-Canu.—The author has examined the crystals of this compound, and ascribes to them the formula $C_8H_8O_4CaCl$. These crystals are quickly decomposed by water. The author is engaged with the study of certain analogous compounds.

Three New Compounds of Iridium.—C. Vincent.—These compounds are formed by iridium perchloride combining respectively with the hydrochlorates of mono-, di-, and tri-methylamine. The mono-compound takes the form of small hexagonal uniaxial tables of a reddish brown bordering on black. The di-compound forms very long brilliant crystals of a somewhat lighter reddish brown. When purified they appear as rectangular octahedra of the orthorhombic type. The tri-compound forms reddish brown crystals, paler than the two former, in the form of octahedra derived from the cube. The ease with which this last compound crystallises may be utilised for purifying iridium from traces of rhodium.

Various Haloidal Substitution Derivatives of Propionic Acid.—L. Henry.—The compounds which the author has examined are β-chloro-propionic acid, β-chlorous propionyl chloride, β-chlorous ethyl propionate, primary propyl chloro-acetate, methyl chloro-propionate, biprimary bichlorous ethyl-propionate, mono-chlorous α-propionyl chloride, primary propyl iodo-acetate, iodo-propionamide, and iodo-acetamide.

Signification of the Polarimetric Experiments executed with a Solution of Cotton in Schweitzer's Liquid.—A. Béchamp.—A reply to certain criticisms of M. Levallois. The author adds that cotton is not merely dissolved in the cuprammonic reagent, but undergoes progressive changes, which terminate in a constant molecular state endowed with peculiar properties, but still retaining certain characters of cellulose.

Influence of the Light of the Sun on the Germs of Microbia.—E. Duclaux.—The author's results show that the light of the sun is a hygienic agent of great power, at least fifty times more efficacious than its heat.

MEETINGS FOR THE WEEK

Monday, Feb. 2nd.—London Institution, 5.
— Medical, 8.30.
— Society of Arts, 8 (Cantor Lectures.) "The Distribution of Electricity," by Prof. George Forbes, M.A., F.R.S.E.
— Royal Institution, 5. General Monthly Meeting.
— Society of Chemical Industry, 8. "The Russian Petroleum Industry," Dr. Boverton Redwood.

Tuesday, 3rd.—Royal Institution, 3. "Colonial Animals," by Prof. Moseley.
— Institution of Civil Engineers, 8.
— Pathological, 8.30.

Wednesday, 4th.—Society of Arts, 8. "Education in Industrial Art," by Charles G. Leland.
— Pharmaceutical, 8.

Thursday, 5th.—London Institution, 5 and 7.
— Royal, 4.30.
— Royal Institution, 3. "The New Chemistry," by Prof. Dewar.
— Royal Society Club, 6.30.
— Society of Arts, 8, (Howard Lectures.) "The Conversion of Heat into Ueful Work," by W. Anderson, M.Inst.C.E.
— Chemical, 8. Ballot for the Election of Fellows. "Chemical Changes effected by Micro-Organisms," by Prof. Frankland, F.R.S.

Friday, 6th.—Royal Institution, 8. "Thought, and the Phenomena of Nature," by Mr. G. Johnstone Stoney, at 9.
— Geologists' Association, 7.30.

Saturday, 7th.—Royal Institution, 3. "The Scale on which Nature Works, &c.," by Mr. G. Johnstone Stoney.

THE CHEMICAL NEWS.

Vol. LI. No. 1315.

A NOTE ON THE ANALYSIS OF SUPERPHOSPHATES AND SIMILAR FERTILISERS.

By JOHN RUFFLE.

In the analysis of phosphatic manures, the usual method is to treat one portion with cold water for the soluble phosphoric acid, and to dissolve another portion with hydrochloric acid for the total phosphoric acid, in each case precipitating by "magnesia mixture;" the soluble deducted from the total gives the insoluble by difference.

In the Chemical News, vol. xxxi., p. 209, Mr. John Hughes pointed out that hydrochloric acid solutions of certain raw phosphates should be evaporated to dryness to get rid of the soluble silica, which otherwise would be wrongly included in the phosphate of magnesia precipitate; this has now become general, and observation has shown me that this evaporation to dryness should be extended to the manures made from these and similar phosphates—such are largely used—more especially when it is desired to estimate the "insoluble," as seen by the results below, which are from large parcels of different manures, and represent a large tonnage.

	1. P_2O_5 =	Tricalcic Phosph.	2. P_2O_5 =	Tricalcic Phosph.	3. P_2O_5 =	Tricalcic Phosph.	4. P_2O_5 =	Tricalcic Phosph.
The "Total" not evaporated	14·25 =	31·10	13·34 =	29·12	14·42 =	31·48	14·52 =	31·69
Do. evaporated	13·85	30·23	12·49	27·26	13·79	30·10	13·80	30·12
Difference	0·40 =	0·87	0·85 =	1·86	0·63 =	1·38	0·72 =	1·57
"Soluble"	10·53 =	23·00	11·82 =	25·80	11·53 =	29·53	13·16 =	28·72

	5. P_2O_5 =	Tricalcic Phosph.	6. P_2O_5 =	Tricalcic Phosph.	7. P_2O_5 =	Tricalcic Phosph.	8. P_2O_5 =	Tricalcic Phosph.
The "Total" not evaporated	14·52 =	31·69	14·05 =	30·67	13·97 =	30·49	13·97 =	30·49
Do. evaporated	14·51	31·67	13·03	28·44	13·01	28·40	13·81	30·14
Difference	0·01 =	0·02	1·02 =	2·23	0·96 =	2·09	0·16 =	0·35
"Soluble"	13·92 =	30·38	12·91 =	28·18	12·57 =	27·44	12·89 =	28·14

	9. P_2O_5 =	Tricalcic Phosph.
The "Total" not evaporated	13·96 =	30·47
Do. evaporated	13·40	29·25
Difference	0·56 =	1·22
"Soluble"	12·91 =	28·18

Where it is a question of paying for the "insoluble," as in dissolved bones, &c., or guiding the manufacturer, such differences as Nos. 4, 7, &c., are of value.

The soluble silica sometimes shows in the "soluble" by a flocculence in the beaker above the precipitate, instead of all being dense and granular; the error due to this is, however, small, varying up to 0·50 per cent of phosphate, and can most conveniently be dealt with by dissolving the burnt magnesium phosphate precipitate in hydrochloric acid, filtering, duly drying and burning. The small quantity of silica—some few milligrammes—so obtained can then be deducted from the weight of the phosphate of magnesia precipitate.

James Gibbs and Co.'s Chemical Works,
London, E.

ON THE ACTION OF BORIC ACID ON CALCIUM CARBONATE IN THE COLD.

By LESTER REED, F.C.S., A.I.C.

It is, I believe, a known fact that CO_2 may be slowly displaced from chalk by *boiling* it in a solution of boric acid. It appears, however, from a number of experiments which I have made that this action is not entirely dependent upon a high temperature. I have made mixtures of chalk and boric acid in varying proportions, the two ingredients being both ground to an impalpable powder, and made up with water to the consistency of a thick paste, which was allowed to dry spontaneously, sometimes in balls and sometimes spread out as a thin coating on wood. In a few days the mixture acquired in some cases a surface hardness so great as to be only with difficulty scratched by the finger-nail. This occurs when the proportion of boric acid to chalk is as small as 1 : 30; the hardening does not take place properly with 1 : 40.

In one case I succeeded in obtaining a very sharp and clear impression in this mixture from a penny, resembling a cast in plaster-of-Paris, and having an excellent surface.

It is a noteworthy fact that even in a mixture containing much more boric acid the hardening is greatly hindered by the addition of very small quantities of foreign substances, such as iodide of mercury, ultramarine, or chromate of lead.

On examining the dried mass it is found to be quite soft below the surface, which apparently consists of a layer of some borate of calcium not thicker than the thinnest paper, but nevertheless very hard, and capable of standing for a few seconds even the action of water. Possibly the action below the surface is arrested by the pressure caused by the compact layer above it, which prevents the escape of CO_2. Capillary attraction also may have something to do with the rising of the boric acid to the surface.

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REVERSION OF PHOSPHORIC ACID BY HEAT, TOGETHER WITH SOME OBSERVATIONS ON THE FINE GRINDING OF ANALYTICAL SAMPLES.

By W. B. PHILLIPS, Ph.D.

When manufactured phosphates are analysed immediately after preparation, the percentage of phosphoric acid soluble in water is generally found to be higher than at any subsequent time. A portion of it becomes insoluble in water, but is soluble in some of the organic salts of ammonia. *i.e.*, in the oxalate and citrate. To this phosphoric acid the term *reverted* is applied, signifying, as is well-known, phosphoric acid which, though at one time soluble in water, has become insoluble in that liquid, and occupies an intermediate position between the original tri-calcium phosphate of the crude material and the tetra-hydrogen-calcium-phosphate of the manufactured product.

The change from soluble to reverted begins almost at the very moment of manufacture, and continues for an indefinite period, varying among other things with the raw material used, the quantity of acid employed, &c.

It might be supposed that as this reversion begins when the product begins to dry, it was connected intimately with the process of drying. But it it has been shown by Post (*Chem. Industr.*, 1882, p. 217), that it goes on even in samples enclosed in hermetically sealed bottles, and hence is not dependent on the loss of moisture, under ordinary conditions of temperature.

The limits of this paper will not allow me to enter at all into the discussion of the various causes of reversion. Among the more prominent ones are the presence of unattacked oxides of calcium, iron, and aluminium, and calcium sulphate and carbonate.

The object of this paper is to direct attention anew to the fact that a temperature of 100° C., maintained for varying lengths of time on the manufactured phosphates, causes a very rapid reversion.

The material used was a sample of an "Acid Phosphate" prepared under my personal supervision at the works of the Navassa Guano Company. It was prepared as follows:—

Fine ground Charleston Rock	..	1100 pounds.
Sulphuric acid, 470 B. ..	..	950 ,,

Several tons of it were made November 21st, 1883, and a sample of it was drawn by myself, November 22nd. The sample was pulverised by hand as fine as possible, and analysed at once.

Fifty grains of the sample were then taken and dried at a temperature of 90° to 100° C. for two days. At the end of that time a sample was drawn, pulverised until it passed through a sieve of 100 meshes per square inch, and analysed.

The drying was continued for eight (8) days longer, at the end of which time a sample was drawn, passed through a 100-mesh sieve, and analysed.

Tabulating these results for convenience of reference we have:—

	A.	B.	C.
On a dry Basis.	24 hrs. after preparation pulverised by hand.	After 2 days at 90° to 100° C. Through 100 mesh sieve.	After 10 days at 90° to 100° C. Through 100 mesh sieve.
	Per cent.	Per cent.	Per cent.
Total phos. acid	17·31	17·13	17·32
Soluble ,,	11·74	10·59	7·48
Insoluble ,,	3·32	2·95	2·85
Reverted ,,	2·25	3·59	6·99
Available ,,	13·99	14·18	14·47

We have here a loss of 4·26 per cent of sol. phos. acid in days, a loss of 0·47 per cent of insol. phos. acid, and a gain of 4·74 per cent of reverted. Ordinarily the loss of soluble is compensated by the gain of reverted, while the insoluble remains about the same. Post, in the article before referred to, claims to have found that in the course of six (6) months, in sealed bottles, some of the soluble becomes so insoluble as not to be dissolved by ammonium citrate at 90° C. But here it is shown that in ten (10) days at a temperature of 90° to 100° C., some of the originally insoluble phosphoric acid, viz., 0·47 per cent, has *become soluble in ammonium citrate at* 40° *C.*, that is, has changed to reverted! But this loss of 0·47 per cent of insoluble phosphoric acid is doubtless due to the very fine grinding of the dry samples. For the difference in insoluble phosphoric acid between the first and second analyses is 0·37 per cent, while the difference between the second and third is only 0·10 per cent. That is to say, the difference between the insoluble phosphoric acid in the sample pulverised by hand and the sample dried for two (2) days and then passed through a 100-mesh sieve, is 0·37 per cent in favour of the finely pulverised. But the difference between the two finely pulverised samples after eight (8) days of drying is only 0·10 per cent.

That the ammonium citrate should dissolve more phosphoric acid from the finely-ground sample is just what was to be expected. When sufficient sulphuric acid is added to the crude tri-calcium phosphate to render *all* of the phosphoric acid soluble in water reversion does not appear to proceed as rapidly as when there is present some of the original undecomposed phosphate. But in this case, when fusing Charleston rock, it is very difficult to obtain a product which will dry in a reasonable time without the aid of artificial heat or some carbonate as a dryer. Using artificial heat there is great danger of hastening reversion, and the same is true if some chemical "dryer" is used, to say nothing of the reduction of the content of total phosphoric acid in this latter case.

There is one point to which I wish to direct especial attention, and that is what I conceive to be the *necessity for fine grinding of the analytical sample.* Plants derive their food from the soil in solutions, and in these solutions the food is in a state of almost inconceivable fineness.

In estimating the value by chemical analysis of any plant food, we should, as far as practical, approximate to the degree of fineness to which the food must be reduced before the plant can use it.

Other things being equal, the finer we grind analytical samples before acting upon them with chemical reagents which in a greater or less degree represent the action of the soil, the nearer do we approach to the methods of nature.—*Journal of the American Chemical Society.*

ON PROUT'S HYPOTHESIS.

By MAXIMILIEN GERBER.

In 1815, Prout, taking his stand on contemporary stoechiometric determinations, concluded that the atomic weights of all the elements are multiples of the atom of hydrogen, taken as unity, by a whole number. The existence of such relations between the elementary weights rendered it possible to consider hydrogen as the primordial matter, from which all the other bodies reputed as simple had been formed by condensation according to laws analogous to those which govern the formation of compound bodies. The unity of matter taught by certain ancient philosophers would be thus, to a certain extent, confirmed by experience.

Subsequently, in accordance with the results of Berzelius, Penny, Marignac, Dumas, and Stas, it was found that, in order to reconcile the hypothesis with experiment, Prout's unit would have to be reduced to the fourth (Dumas), to the eighth, the sixteenth, and even further (Stas).

If reduced to these terms the problem put by Prout is no longer open to our present means of investigation, for precision in experiments has limits beyond which we are no longer justified in concluding anything.

Although the experimental control has thus given negative results, Prout's hypothesis has, nevertheless, remained in the state of a demonstrable truth implicitly admitted in principle by the majority of savants, independently of the unknown magnitude of the unit.

One of our most illustrious chemists has always considered it as the imperfect expression of a natural law. Even those whose researches have contributed most to its rejection in its original form have still felt its influence. "When undertaking this long and difficult study," says M. Stas, in connection with his classical determinations of atomic weights, "I was a warm partizan of the exactitude of the hypothesis of the English chemist."

Not an author mentions it without betraying regret in finding it disagree with experimental facts.

Prout's hypothesis, in fact, and the philosophic doctrine with which it is connected satisfy the natural tendency of our mind to conceive only simple things, and science offers at present no formal and positive indications of a nature to discredit ideas so seductive *a priori*.

Moreover, an argument which has been several times repeated, and which has been lately repeated by M. Boutlerow in a communication presented to the (Paris) Chemical Society justifies, to a certain degree, the conviction as it is which I have expressed above. Among some thirty atomic weights which may be considered as known within some hundredths, twenty at least approximate so closely to whole numbers that our reason refuses to see there a pure accidental coincidence.

Struck with this accordance I asked myself some years ago if Prout's hypothesis might not be presented in a new form more in harmony with modern doctrines on the constitution of matter.

Taking the point of view of the dynamic hypothesis which regards the atom as the result of an undulation of the ether (the hypothesis of Sir W. Thomson and M. Dellingshausen), I assumed that a primary undulation set up in this medium must generate other undulations having with the first relations analogous to those met with in the case of sound-waves.

Admitting, on the other hand, that one of the specific elements of the undulation,—its velocity for instance,—is measured by the weight of the atom, I have sought, in consequence of this twofold hypothesis, for relations among the atomic weights of the same order as those which connect a sound to its different harmonics.

From the outset I explained to myself in this manner the atomic weights of the elements forming a well-marked natural group, *e.g.*, oxygen, sulphur, tellurium, the atomic weights of which are respectively multiples of 16 by 1, 2, and 8. Here we have direct harmonics, having very simple relations with the initial undulation. Between these simple harmonics are placed intermediate terms, series of undulations of an increasing or decreasing velocity, the relations of which with the primary wave will be relatively more complex, but which themselves have their simple harmonics. I saw here the periods, I might almost say the groups, of Mendelejeff.

It would be tedious to insist here on considerations of a character so speculative. I mention them merely to point out the idea which led me to seek among the atomic weights, not numerical relations of addition, as Dumas, Gladstone, Pettenkofer, and Odling have done, but relations of a divisor to multiples, of harmonics to a fundamental sound.

I soon found, indeed, relations precisely similar to those which I expected between various atomic weights, taken two and two, but these relations seemed to me too complex, especially when I sought to establish them between bodies with closely adjacent atomic weights, *i.e.*, by following the Mendelejeffian periods.

On dividing the simple bodies hitherto known into four great classes, characterised by the predominant atomicity of the elements which they contain, I find for each of these classes a common divisor, greater than unity or bordering very closely upon it, so that the atomic weights of bodies of one and the same class are found to be exact multiples of this common divisor by simple, entire factors.

The first of these classes contains the so-called monatomic elements; that is to say the alkaline metals the type of whose oxygen compound is R_2O and the chlorine compound RCl, along with the halogen non-metals, fluorine, chlorine, bromine, and iodine. Common divisor $d_1 = 0·769$.

The second class comprises the elements which are distinctly di- or tetra-atomic; that is to say, the alkaline earthy metals RO and the non-metals of the oxygen and carbon group. Common divisor $d_2 = 1·995$.

In the third class I arrange the elements which generally act as tri- or quinti-valents, nitrogen, boron, &c. The highest type of oxide is R_2O_5 and their chloride RCl_3 or RCl_5. Common divisor $d_3 = 1·559$.

Lastly, the fourth class, by far the most numerous, comprises the metals properly speaking and presenting the two types of oxides RO or R_2O_3. Common divisor $d_4 = 1·245$. I wrote "the common factors which I have employed have been determined empirically, and there does not exist between them any simple relation; they have, therefore, in themselves, no value."

Some weeks later, the Abbé Moigno communicated to me a letter from the American astronomer, Mr. Earle Pliny Chase, pointing out that:—

The divisors among which your correspondent finds no relation bear to each other the following very simple relations:—

Gerber's Units.	Philotactic Divisors.
$O = 15·96.$	$O = 15·96$
$H = \frac{18}{10}$ $d_1 = 0·9997$	$H = \frac{1}{16}\,O = 0·998$
$d_1 = 0·769$	$d_1 = \frac{5}{13}\,d_2 = 0·7673$
$d_2 = 1·995$	$d_2 = \frac{1}{8}\,O = 1·995$
$d_3 = 1·559$	$d_3 = \frac{5}{2}\,\frac{5}{8}\,H = 1·559$
$d_4 = 1·245$	$d_4 = \frac{5}{8}\,d_2 = 1·247$

If we express all these factors as functions of H, the ratio H/O being admitted $= \frac{1}{16}$, and calculate the values of the divisors on the basis $O = 16$ and $O = 15·96$, we find:—

For	$O = 15·96.$	$O = 16.$
$d_1 = H\frac{10}{13}$	$= 0·7673$	$0·76923$
$d_2 = 2H$ or $1H$	$= 1·995$	$2·00$
$d_3 = H\frac{25}{16} = H(\frac{5}{4})^2$	$= 1·5586$	$1·5625$
$d_4 = H\frac{5}{4}$	$= 1·246875$	$1·25$

Three of my former empiric factors fall between these two series of values. We find that:—

1. Multiples of these four divisors by whole numbers comprise all the atomic weights sufficiently known.

2. To each divisor there correspond all the elements of one and the same natural group.

3. An atomic weight generally finds in one only series a multiple sufficiently near to be confounded with it, and this series is precisely that to which belong the atomic weights of all the similar elements.

The author then gives a series of tables comparing the atomic weights according to the most recent determinations with the values calculated from his divisors. It will be seen that the agreement between these two sets of values is such that it cannot be desired more complete. In a great number of cases the atomic weights as determined with precision by recognised experimentalists, and admitted after a criticism of the analytical methods and the possible errors, lie between the values calculated on the basis $O = 16$ and on $O = 15·96$. In general the deviation is trifling and falls within the limit of experimental error.

When discussing in my former investigations the value of these numerical relations I pointed out some defects.

The first of these, referring to the absence of simple relations between the units determined empirically, has since, as we have seen, received the most satisfactory solution.

Here is the second:—If, on the one hand, it is remarkable to find between the members of well-defined natural groups relations so simple as for O, S, Te, . . Li, K, Rb, &c., we find, on the other hand, similar elements such as Cl, Br, I, which present, apparently, relations much more complex. In the group of alkaline metals, for instance, cæsium departs from the special regularity. If we look merely at the first four elements Li, Na, K, Rb, the common divisor seems not d_1, but $3d_1$. But, in order that the atomic weight of cæsium may be multipled by $3d_1$, it must be reduced by about 0·8, *i.e.*, $1 \times d_1$. In the same manner, in the very closely connected family of the alkaline earthy metals, if the common divisor of the first three terms Mg, Ca, Sr is applied to barium, the atomic weight Ba will be $= 17 \times 4d_2$, that is to say $68d_2$, whilst the atomic weight which is found corresponds to $68\frac{1}{2}d_2$.

The deviation between the admitted atomic weight and the multiple of $4d_2$, attributed to barium by analogy, is also equal to $1 \times d_2$. In the oxygen group selenium presents a perfectly analogous irregularity.

A third remark bears on the classification which I have adopted. There are elements which may be placed with the same calulated atomic value in two different classes. It is at once seen, for instance, that the terms of progression, the ratio of which is d_4, frequently coincide with the terms of the progression d_3, $4d_3 = 5d_4$. An element having an atomic weight the multiple of $4d_3$ or of $5d_4$ may be placed in both series.

Zinc and mercury may be arranged indifferently in the series d_2 and d_4. Thus we have—

For zinc: $52d_4 = 31\frac{1}{3}d_2 = 64·8375$ and 65.
For mercury: $100d_4 = 100d_2 = 199·5$ and 200.

Still we can see nothing abnormal in this fact. Zinc and mercury are thus found to belong at once to the series d_4, where come almost all the elements to which they approximate by their metallic characters and to the series d_2, comprising the diatomic elements among which zinc and mercury are grouped in Mendelejeff's classification. But $104d_1$, which expresses the atomic weight Br, $= 40d_2$. And bromine presents no particular affinities which approximate it to the elements of the second series, with which it has nevertheless numerical relations of the most perfect simplicity. This is a difficulty.

For the other elements, the atomic weight of which is not known with sufficient accuracy, the series to which they should be assigned remains doubtful. Thus I place manganese along with iron, cobalt, and nickel in the series d_4 with the calculated atomic weight 54·86 and 55. But this element might equally be arranged according to the analogies appearing from the periodic classification in the series d_1 with the calulated atomic weight 54·48 to 54·61. We generally admit Mn = 54·8. In reality the various analyses oscillate between 54 and 55, and the case is undecided.

Glucinium presents a difficulty of the same kind. Since the researches of Awdejeff this element has been considered as forming one of the family of diatomic alkaline-earthy metals Mg, Ca, Sr, Ba, and, consequently, forming an oxide GO with $G'' = 9·3$. The specific heat of glucinium, determined by Reynold, seemed to confirm this view, and in the periodic classification $G''' = 9·3$ was naturally placed betweed Li = 7·02 and Bo = 11, whilst G''' forming an oxide of the type R_2O_3 finds no place in the periodic system.

More recently, Nilson and Pettersson have inferred from a careful study of glucinium and its combinations that its chemical analogies and its atomic heat tend to restore, for its oxide, the old formula of Berzelius, G_2O_3; consequently, G must have an atomic weight 1·5 times greater that is $G''' = 13·65$.

In the present state it is impossible for me to arrange glucinium among the diatomic elements Mg, Ca, &c. The atomic weight G'' cannot be expressed as a direct function of d_2, nor of any other of the three units. On the contrary, I find a multiple of d_4 which agrees closely with the atomic weight $G''' = 13·65$ ($11d_4 = 13·72$ or 13·75).

I shall not further discuss the exceptional points to which I have just referred. We may regard them as objections, but I believe at least not as positive contradictions to the general principle of this investigation.

During the last two years it has repeatedly happened that atomic weights, when more accurately determined, have been found capable of arrangement among the multiples of my divisors in the series which their respective affinities pointed out.

Thus tellurium, with the atomic weight 127·84, as determined by Wills, corresponds to the multiple $64d_2 = 127·68—128·00$.

Platinum, Pt = 194·34, as found by Seubert, finds its place in the series d_4: $156d_4 = 194·51—195$.

Lastly, antimony, for which Cooke had established the atomic weight 120·02, falls in the series d_3: $77d_3 = 120·1—120·31$.

Neither platinum nor antimony could be arranged with the atomic weights formerly admitted (196 or 197 for Pt; 122 for Sb) in the series to which they are suitable.

Conclusions.—From these researches I believe that I may infer—

1. The existence of a common unit, in general greater than 1, among all the elements belonging to the same natural group.

2. The existence of simple relations among the four common units the multiples of which comprise all the atomic weights with an approximation as close as can be at present desired, and consequently—

The existence among all the elementary weights of simple relations, though different from those which Prout admitted.

I do not insist on the speculative idea which led me to seek for relations of this order among the elementary weights, its present form being very vague, and the facts themselves upon which I sought to support it being not incapable of discussion.

The interval between the two consecutive multiples of one and the same divisor is so great that future stoechiometric determinations may decide whether the numerical relations which I believe I have found among the atomic weights rest upon a mere play of numbers, or, if they correspond, to a natural reality.—*Bulletin de la Soc. Chimique.*

ABSOLUTE ETHER.*

The strength of ether, like that of alcohol, is almost entirely judged of or determined by specific gravity. The other constants of the liquids are the boiling-points, but both are so liable to present the appearance of boiling at temperatures both above and below their true boiling-points that this constant is not a trustworthy indication of strength for either liquid in practice. Besides, the boiling-points present smaller differences than the densities and are far more difficult to take with accuracy.

The authorities on the subject of ether which is entirely pure, or free from alcohol and water, are nearly as discordant and as confused as in the case of alcohol, and the differences as great, and therefore the writer's long experience with the substance and his good opportunities for research have induced him to investigate the substance.

While the admixture of alcohol with water is attended with a rise of temperature which varies with the proportions of the two liquids and gives a varying contraction, thus giving a curve in the line of expansion, and an irregular coefficient,—ether when mixed with alcohol is marked by a fall of temperature and gives a larger coefficient of expansion, which is more uniform. It thus

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* From "An Ephemeris of Materia Medica, Pharmacy, Therapeutics, and Collateral Information." By Edward R. Squibb, M.D., Edward H. Squibb, S.B., M.D., and Charles F. Squibb, A.B.

becomes easier to compare the statements of the different authorities in regard to ether, by reducing them to a common temperature.

The following are a few of the prominent authorities upon the density of absolute ether:—

Dumas and Boullay ..	0·713 at 20°.C.
Saussure and Thenard..	0·7155 at 20° C.
Gay-Lussac	0·7119 at 25° C.
Richter	0·706 to 0·710 at 20° C.
Boullay	0·690. No temperature given.
Kopp..	0·73658 at 0° C.

These are the six authorities of eleven quoted in "Gmelin's Handbook," Cavendish Society edition, vol. viii., p. 175,—which give the lowest specific gravities.

Kopp is quoted in "Constants of Nature," Smithsonian Institution, as giving 0·73568 at 0° C., but it is doubtful if this be not an accidental transposition of a figure in copying—Gmelin having the more correct reading for the same sp. gr.—namely, 0·73658.

The Dictionaries of both Watt and Wurtz give 0·723 at 12·5° C., the second authority giving this as having been the determination of Gay-Lussac.

Mendelejeff, quoted at second hand, gives 0·73644 at 0° C.

The two most recent authorities are Allan ("Commercial Organic Analysis," 1879, vol i., p. 134), who gives "0·713 at 15° C., or 0·7185 at 17·5° C.;" and Roscoe and Schorlemmer ("Treatise on Chemistry," 1882, vol. iii., Part i., p. 333)—" at 0° it possesses a specific gravity of 0·73568, and at 15° of 0·70240."

Each of these more recent authorities gives a pair of specific gravities, and each has a serious error which is apparent to even casual inspection to such as are familiar with the subject, but which is very confusing to those who are not, and who use the authorities for trustworthy reference.

Allen gives his higher sp. gr. for his higher temperature, which of course is exactly wrong, since the density diminishes by expansion through increase of temperature. Neither of his specific gravities agree with other authorities, and yet he could not have taken both himself,—at least not from the same ether.

Roscoe and Schorlemmer quote Kopp and Andrews for the boiling-point figures in the sentence preceding that for specific gravity, but give the specific gravities, by inference, as being their own. The sp. gr. at 0°, however, namely, 0·73568, is the one occasionally quoted as that of Kopp, wherein a figure is supposed by this writer to have got transposed, since Gmelin and others quote Kopp as 0·73658 at 0°. The second sp. gr. is, however, wholly incompatible with either of these, since 0·73568 at 0° is about equivalent to 0·71888 at 15°, while 0·73658 is equivalent to 0·71978, both seriously at variance with "0·70240."

The writer's determinations for absolute ether, as given farther on, are 0·73128 at 4° C. and 0·71888 at 15° C.—difference for 11° C. 0·01240;—or for 1° C. 0·00127+. Adopting then the quantity 0·00127 as the coefficient of expansion for 1° C., and by it bringing all the authorities above quoted to the uniform temperature of 15° C., they stand very nearly as follows:—(See Table next column).

The chief difficulties in regard to absolute ether are first, to get it free from alcohol, air, and water, and next, to take the sp. gr. of so volatile a liquid, which is so exceedingly sensitive to changes of temperature, with accuracy; and therefore the above discrepancies indicate the means at the disposal of the observers, and the skill and accuracy with which they were applied; and from this consideration it is highly probable that the results of Mendelejeff are the most trustworthy for the present time. With the return of cold weather the writer hopes to resume his investigations, and it is possible then that his own conclusions may be better supported.

			Equivalent to—
Dumas and Boullay's	0·713	at 20°	0·71935 at 15°
Saussure and Thénard	0·7155	,, 20°	0·72185 ,, 15
Gay-Lussac	0·7119	,, 25°	0·72460 ,, 15

Richter .. 0·706 to 0·710 ,, 20° too indefinite for computation, but mentioned because much lower than any other authority met with, with the possible exception of Boullay, who is quoted by Gmelin 0·690, but without any temperature given.

			Equivalent to—
Kopp, as quoted by Gmelin	0·73658	at 0°	0·71753 at 15°
,, ,, others	0·73568	,, 0°	0·71663 ,, 15
Watt and Wurtz	0·723	,, 12·5°	0·71982 ,, 15
Mendelejeff	0·73644	,, 0°	0·71739 ,, 15
Allen	0·7185	,, 17·5°	0·71532 ,, 15
,, ...	0·713	,, 15°	0·713 ,, 15
Roscoe and Schorlemmer	0·73568	,, 0°	0·71663 ,, 15
,, ,,	0·70240	,, 15°	0·70240 ,, 15
The writer's determination	0·73128	,, 4°	0·71888 ,, 15

The work of all the earlier authorities on absolute ether was rendered very difficult and uncertain for want of indicators of the presence of minute quantities of alcohol and water, so that much of the ether was supposed to be free from these, when in reality it was not so; and although much better indicators are now known and easily applied, it is still doubtful whether these are absolute in their indications, so that all that can be fairly claimed is an important progress toward the desired completeness of result.

The rapidly increasing importance of ether, not only as an anæsthetic in medicine, but as a discriminating general solvent in the arts and sciences, makes it of increasing importance that its properties should be more certainly and more accurately known, and in this interest the present paper is offered, in the hope that the writer's long experience and excellent opportunities with the substance may enable him to throw some new light upon the subject of its strength and purity, and the means by which those may be definitely ascertained.

In the *American Journal of Pharmacy* for September, A856, vol. xxviii., p. 385, the writer published an article, entitled "Apparatus for the Preparation of Ether by Steam." This was the result of an experience of about three years with various apparatus which led up to this one, and the design there given, with modifications of detail, and increase in size and capacity, has now been in constant use for over thirty years, yielding a uniform ether of excellent quality in large quantities. The writer believes that he was the first to use steam heat for the manufacture of ether, or at least the first to publish the fact that the steam from ordinary steam boilers, carrying forty to sixty pounds pressure to the square inch, could be easily utilised for the etherification of alcohol, thereby rendering the process far more safe, easier, more convenient, and more economical, and at the same time yielding ether of much better quality.

The modifications of this apparatus, now in successful use, vary very little in design, and not at all in the principles involved from the original as published, although very much larger. The same general form of still and internal steam coil of heavy lead, is followed by a cast-iron purifier, the larger lower chamber of which contains a solution of potassa renewed every day. This chamber has a wire gauze diaphragm, always immersed in the solution, to divide the bubbles of vapour, and has a steam coil to keep the solution heated above the boiling-point of alcohol, so that the vapours of ether and of alcohol, which has escaped etherification, are finely divided and thoroughly washed in the alkaline solution. Surmounting this chamber are five smaller plunger chambers, of the same form and arrangement as the chambers of an alcohol column. In these the mixed vapours, still kept above their condensing points, are washed five times in succession by a descending current of hot distilled water coming from above. Escaping from this series of washings, the vapours, now consisting chiefly of alcohol and ether, and uncondensable gases, enter a second purifier. This consists of a large block-tin worm which terminates in a central cylinder furnished with wire gauze diaphragms, upon which rest about two inches of round pebble stones. From the bottom of this cylinder a small block-tin tube leads the liquid condensed by it to a small, cold, condensing-worm, from which the liquid is conducted to the feed-back of the still, where it is received into the fresh supply of alcohol for the still. At the top the cylinder communicates with the large block-tin condensing worm for the purified ether. The block-tin worm and central cylinder which constitute this second purifier are placed within a large sheet-iron tank supplied with water at a temperature of 35°C., or 95° F., kept at a constant temperature throughout, by means of a long upright shaft supplied throughout its length with propeller blades. This shaft is kept in motion by the power of the current of water which supplies the final large condensing worm.

The still is first charged with about thirteen gallons of alcohol or clean spirit, and into this about two carboys, or 360 lbs., of concentrated sulphuric acid is run slowly in a small stream. The still is then closed and heated to the etherifying point of about 130° C., or 266° F., the purifiers being charged and heated up at the same time. The temperatures of the various parts being now kept steady, the apparatus is nearly automatic. After a portion of ether has been distilled off from the commencing charge, and the temperature of the contents of the still begin to rise, the supply of fresh alcohol from the feed-back is turned into the still, and so regulated as to keep the mixture nearly at a constant quantity and temperature. The vapours are washed in the first purifier, and then the second purifier, being kept at such a temperature as not to condense the pure ether and the proportion of alcohol which must go with it by the laws which govern the tension of the mixed vapours,—separates all the separable alcohol and other vapours of higher boiling-points than ether, and draining these off from the enormously multiplied surfaces of the pebble stones, delivers them into the fieed-back to be again subjected to the action of the acid in the still. Thus the separable alcohol which has escaped etherification is returned to the still with the fresh alcohol, until all is etherified; and the purified ether vapour, with its 4 to 4·2 per cent of inseparable alcohol, passes over to the final condensing worm, and thence, condensed and cooled, into the storage reservoir. The present apparatus is of such a capacity as to etherify about one barrel of clean spirit each working day of nine and a half hours, and, with the exception of two to three months of summer, when even the well-water is not cold enough to give an economical condensation, it is run from year to year. If the spirit or alcohol be of good quality and clean, the sulphuric acid does not require changing oftener than once in each running, and then only because it gets so dark and tarry by the charring of the impurities of the alcohol as to render the mixture in the still liable to frothing. The one charge of acid will generally etherify, without much inconvenience, about 120 barrels of clean spirit, when it becomes economical to throw it away and put in a fresh charge. In splitting the alcohol into ether and water, both distil over, leaving the acid unchanged, except by accidental foreign matters in the spirit—the water accumulating in the lower chamber of the first purifier, to be run off with the solution of potassa at the end of each day. Nothing could be more effective or convenient than this apparatus, either in facility of management or quality of the product, and nothing short of the grossest carelessness or inattention can interfere with the uniformity of the product. First, with the personal attention of the writer, and, afterward, by the services of a succession of intelligent and capable men, it has passed through six different generations or renewals within thirty odd years, without a single serious accident, and always yielding a satisfactory product in the writer's experience. The apparatus has been copied, by the writer's consent, by four other manufacturers, but without yielding results so satisfactory in quality of product. But in two instances, where it was made for others by the writer's own mechanics, lent for the purpose, the defective quality of product could be traced to the omission of the second purifier, or the substitution of some less expensive and less effective form of this important part.

The apparatus could easily be run night and day, by a double set of hands, if lighted from outside the building, but it is not the least of its merits that it can be stopped over-nights and Sundays without serious loss or disadvantage. For the entire process, including the putting up of the product, three good men are required, exclusive of the labelling and wrapping, and of course all who are employed about so volatile and so inflammable a substance must be of a class that renders the services expensive, while the plant itself is an expensive one.

The quantity of alcohol and spirit etherified by the writer with this apparatus now amounts to many thousand barrels, and the strength of the alcohol has perhaps averaged about 91 per cent. The possible theoretical yield of absolute ether from alcohol of this strength is about 4·85 pounds to the gallon, but this apparatus, upon an average of large quantities, does not yield over 4 pounds to the gallon. That is, the available product, put up, is about 4·1 pounds of ether of a strength of 95 to 96 per cent to the gallon. But all packages are put up about 4 per cent over weight, and there is some loss in bottling and by breakage. So that the net yield of the stronger ether is about 4·26 pounds to the gallon—4·1 pounds, or thereabout, being realised. This ether, as produced for a long time past, has a specific gravity which varies very slightly from the following figures:—

	Compared with water at 4° C. = 39·2° F. as unity.
Weighed at 4° C. = 39·2° F.	0·73662
„ 15° C. = 59° F.	0·72450
„ 15·6° C. = 60° F.	0·72384
„ 25° C. = 77° F.	0·71354

all the specific gravities being apparent or uncorrected.

The ether is quite clean and practically free from everything except alcohol and water. Of this ether about 8 litres was taken and shaken twice in the shaking machine (Chem. News, vol. li., p. 10) with its own volume of distilled water, for about two hours. The separated ether was then again shaken three times with about one-third its volume of water. By this management about one-third of the ether was washed away, and probably very nearly all the alcohol was washed out of the remainder, leaving this fully saturated with water. The washed ether was put into two bottles, and to each was added about half a pound of fused chloride of calcium which had been first ground to powder and then re-heated to a point just short of fusion. The bottles were then shaken three times for about 15 minutes at intervals of an hour, and allowed to stand a week with occasional hand agitation, and were then shaken again by the machine as before. This week of digestion and shaking were repeated a third time, after which the clear supernatant ether was aspirated into the distilling apparatus described at page 10, under "Absolute Alcohol." From this it was distilled under a partial vacuum of about 15 inches, by the application of a water-bath with water just warm enough to counteract the cold produced by the rapid evaporation or boiling of the ether. The distillate was received in six fractions. The first and last of these were small fractions, and were not weighed. The four other fractions, of about 750 c.c. each, were very carefully weighed in the flask previously illustrated (Chemical News, vol. li., p. 9), with the following results, water at 4° C. being taken as unity:—

First fraction—
Weighed at 4° C., 0·73128, uncorrected or apparent.
„ „ 15° C., 0·71908, „ „ „
„ „ 15·6° C., 0·71838, „ „ „
„ „ 25° C., 0·70788, „ „ „
Compared with water at 15·6° C. = 60° F., as unity.

Weighed at 15° C., 0·71890, apparent or uncorrected.
,, ,, 25° C., 0·70842, ,, ,, ,,
Second fraction—
Water at 4° C., being taken as unity.
Weighed at 15° C., 0·71912, apparent or uncorrected.
Third fraction—
Weighed at 15° C., 0·71916, ,, ,, ,,
Fourth fraction—
Weighed at 15° C., 0·71928, ,, ,, ,,

Had this ether been entirely free from alcohol and water it should have had the same specific gravity thoughout the distillate. No part of it was, therefore, entirely absolute for reasons similar to these given in regard to alcohol (Chemical News, vol. li, p. 22).

The first fraction may, however, be accepted as very nearly absolute, or at least as nearly so as any yet obtained by this writer, or as obtainable by water and chloride of calcium in the ordinary way.

Another portion of about five litres of very good ether was well washed with water by hand shaking, and was then digested upon well-burnt quick-lime for four months, with frequent shaking by hand. This was separated from the lime and distilled in the same way as the first portion, but gave a higher specific gravity and a greater difference between the fractions.

Both these portions of nearly absolute ether were separately set aside in well-stopped bottles with a fresh portion of recently fused and powdered chloride of calcium to be occasionally shaken by the machine until next winter, when a low temperature may enable the work to be resumed under more favourable conditions, and when a greater length of digestion may establish a better balance between the affinities in the reactions with the chloride of calcium.

It is stated by several good authorities that absolute ether in contact with moisture, or even with moist air, regenerates small proportions of alcohol, and if this be true it materially increases the difficulties of the problem of absolute ether.

The recognition of absolute ether, even by the more recent tests, is by no means easy. The test by admixture with equal volumes of oil of copaiba, or of carbon disulphide, is not at all critical, as the ether obtained by the writer does not show the faintest cloudiness with either of these liquids when previously mixed with 0·1 p.c. of watery alcohol.

(To be continued).

PROCEEDINGS OF SOCIETIES.

ROYAL INSTITUTION OF GREAT BRITAIN.

General Monthly Meeting, Monday, February 2, 1885.

The Hon. Sir William R. Grove, D.C.L., F.R.S., Vice-President, in the Chair.

The following gentlemen were elected Members of the Royal Institution:—Arthur Edward Durham, F.R.C.S., James Love, F.R.A.S., F.G.S., F.Z.S.

The special thanks of the Members were returned for the following donations to the Fund for the Promotion of Experimental Research:—Warren De La Rue, Esq., £100; Sir Frederick Bramwell, £50.

The special thanks of the Members were returned to Miss Julia Moore, for her present, on behalf of her sister, the late Miss Harriet Moore, M.R.I., of a fine copy of Dante's "Divina Commedia," printed in 1564; and also three water-colour drawings of the Old Laboratory of the Royal Institution, including portraits of Prof. Faraday, and his Assistant, Mr. Anderson, painted by Miss H. Moore. These ladies were nieces of General Sir John Moore, who died at Corunna, January 16, 1809.

The presents received since the last meeting were laid on the table, and the thanks of the Members returned for the same.

OBITUARY.

PROFESSOR SILLIMAN.

To the names of the many eminent chemists whom we have lost within a comparatively short time must be added that of Benjamin Silliman, for many years Professor of Chemistry at Yale College, and one of the most distinguished representatives of Science in America. Prof. Silliman was born at New Haven, Dec. 4th, 1816. He entered Yale College as a student in 1833, and graduated in 1837. He was at once employed as teacher in the Department of chemistry, mineralogy, and geology. The next year he was associated with his father as joint editor of *Silliman's Journal of Science*,—now known as the *American Journal of Science*,—a post which he filled for the next seven years. In 1846 he was called to the Chair of Applied Chemistry at Yale. In 1847 he was concerned along with Prof. J. P. Norton in founding the Yale Scientific School, since re-named the Sheffield Scientific School. In 1849 he accepted the Professorship of medical chemistry and toxicology in the University of Louisville, and discharged its duties until the death of his father in 1854. Hereon he was called to the chemical chair at Yale, and retained it to his death.

The late *savant* was, almost to the end of his life, connected with industrial exhibitions. He visited Europe in company with his father in 1851, and in conjunction with C. R. Goodrich he edited the "World of Science, Art, and Industry," in addition to a treatise on "The Progress of Science and Mechanism," in both of which he expounded the results of the Crystal Palace Exhibition.

Among his other writings must be mentioned "First Principles of Chemistry," published when entering upon his duties as Professor at Yale, and "First Principles of Physics," published in 1858. His papers read before learned societies and published in the scientific journals are very numerous. It may be mentioned that he was one of the fifty original members of the American National Academy of Sciences. He was also a trustee of the Peabody Museum of Natural History, and for many years State Chemist of Connecticut.

He took an active part in the last meeting of the American Association, where over fatigue brought on the illness which proved fatal. He died on the 14th of last month, honoured throughout the scientific world and lamented by all who had the pleasure of his personal acquaintance.

PROFESSOR VON BAUMHAUER.

We much regret having to announce the death of Prof. Edouard Henri von Baumhauer, which took place at Leyden on the 18th ult. The deceased *savant* was for many years, and up to his death, Perpetual Secretary of the Netherland Society of Sciences at Harlem. He was besides a Member of the Royal Society of Sciences of the Netherlands, and a Knight-Commander of the Dutch Orders of the Lion and the Oak Crown. He has repeatedly been charged with the duty of presiding over the Dutch departments at international exhibitions in foreign countries.

New Series of "Cosmos les Mondes."—We learn that a new series of *Cosmos les Mondes* was commenced on February 1st. The journal will be, as we understand, considerably enlarged, and will contain certain novel features.

NOTICES OF BOOKS.

Nature's Hygiene: A Systematic Manual of Natural Hygiene, containing an account of the Chemistry and Hygiene of the Eucalyptus and the Pine. By C. T. Kingzett, F.I.C., F.C.S. Second Edition. London: Ballière, Tindall, and Cox.

This work, in its present form, is very different from the former edition, which we had the pleasure of noticing about four years ago. The greater portion of it has been re-written, and several new chapters have been added on Water Supply, Sewage Disposal, Infectious Diseases, and the Treatment of the Sick.

Of the introductory chapters a great portion seems to us to fall to the ground between two stools. They are devoted to a consideration of the constitution of matter, of the chemical elements, chemical compounds, symbols, formulæ, &c. Now to chemists, and indeed to the majority of persons who have enjoyed anything like a scientific training, these chapters will be needless. On the other hand, those who have not been so fortunate will scarcely care to grapple with chemical equations and structural formulæ,—not, perhaps, absolutely necessary for an understanding of the subsequent portions of the book. The best feature in these introductory chapters is without doubt the account of hydrogen peroxide, a compound often ignored by popular declaimers on the sanitary value of ozone. Such persons may perhaps be shocked to learn that "it cannot be said with certainty that ozone ever occurs in the atmosphere at all." Yet such is undoubtedly the fact: of all the alleged tests for ozone not one is affected by it, and by it alone.

But when the author comes to speak of water and water-supply, we are compelled to form a much higher estimate of his instructions. On this, and on other departments of sanitary science, he treats most ably and judiciously, observing a golden mean between the views of rival theorists. Concerning the mineral constituents of natural waters, we cannot unreservedly endorse his views when he writes:—"It is only the organic matter that may render the water unfit for potable purposes." A refutation of this contention is supplied by the very passage given in its support. "A general support is given to this statement by the well-known fact that so-called mineral waters are taken on account of their reputed medicinal value, which is due to the salts that are present in large quantities." True; but on this very account such waters are improper as an ordinary beverage. Not a few of them are quite unsafe for persons in health, or for those sick of any disease save the one for which they are recommended.

Mr. Kingzett takes up the more important question of the organic pollution of the Thames. He does not accept implicitly the well-known dogma that "rivers which have received sewage, even if that sewage has been purified before its discharge, are not safe sources of potable water." He asks, "how is it that the water taken from the river and delivered for consumption in the Metropolis is so comparatively pure, anyhow as regards the actual quantity of foreign substances present therein?" After making due allowance for other agencies, he sees that a great part of the purification of the water is due to oxidation. He describes Dr. Tidy's experiments on the prolonged exposure of water to the air, and considers that they give evidence of the oxidation due to the action of the air. He thinks, however, that the statement attributed to Dr. Tidy, viz., that sewage pollution entering the Colne is "entirely destroyed after proceeding half a mile," contains an exaggerated view of the truth. He shows that according to Dr. Odling's analyses the water passing daily through Teddington Lock contains 17¼ tons of dissolved oxygen. But by the time the same volume of water has reached Somerset House it is found to have lost from 12 to 13 tons (say two-thirds) of its oxygen. How can this disappearance of oxygen be accounted for save on the supposition that it has been spent in oxidising, *i.e.*, burning up the organic impurities in the water?

Mr. Kingzett thinks that Dr. Jabez Hogg's well-known reply to Mr. Sorby does not diminish the force of the latter's contention.

Exception might very justly be taken to Dr. Hogg's instance of the defiled well at the Caterham Waterworks. Water pumped out of a deep well and let into the mains of a town is placed under circumstances totally unlike that of water flowing in a river. In the water-works there is not the prolonged flow open to air and light, and there are no organisms, animal or vegetable, capable of exerting an oxidising action. Hence this alarming anecdote is, to say the least, of doubtful relevance.

The author is decidedly of opinion that no untreated sewage should be allowed to enter the Thames from its source to its mouth. He speaks of the attempts of the Metropolitan Board of Works to purify the Thames by throwing in first chloride of lime, and then potassium—or sodium—permanganate, as a procedure which "could only be expected to mitigate in an incomplete measure the nuisance caused by the emission of gases from the putrefying sewage, and that at a very great cost."

We find it here remarked, as a curious fact, that "no paper is ever seen in the sewage of London at the outfalls, so that it must become reduced to an impalpable state of division, or else be decomposed in the sewage." The same phenomenon is observed in the sewage of other towns, if taken at the outfalls. We should consider that its disappearance is due not to decomposition but to fine sub-division. It is this *papier maché* which renders the filtration of sewage, however apparently limpid, almost an impossibility. After a very small quantity has passed through the flow slackens, and soon almost ceases, the surface of the filtering medium being covered with a layer of comminuted paper and the fibrillæ of textile materials, which block up its pores.

Concerning sewage irrigation the author comes to a very sound and practical conclusion. He writes—"The mere fact that, in this country at least, the available land is insufficient for the disposal of sewage by irrigation is sufficiently condemnatory of the process as an exclusive means of utilising sewage. London alone would require above 200,000 acres, and when it is reflected that some classes of soil are not suitable for irrigation, and that great expense has to be incurred in preparing the land by drainage and otherwise to receive sewage, it becomes apparent that for these and local reasons irrigation does not nearly supply the want that is experienced."

We hope that this dose of temperate common sense will aid in the cure of such persons as have been infected with irrigation mania.

Concerning the processes for purifying sewage by precipitation with lime Mr. Kingzett remarks that:—"Precipitation by lime yields an effluent, which from its comparative impurity and alkaline character soon passes into a state of putrefaction, and the lime which passes in solution is fatal to the fish contained in river-water."

The succeeding chapters, discussing infectious and contagious diseases, the theories of disease, antiseptics and antiseptic surgery, disinfectants, the treatment of the sick, &c., appeal rather to the biologist and the physician than to the chemist. We may, however, say that the author does not pin his faith to the germ theory, and points out certain serious difficulties in its application to observed phenomena. If pathogenic microbia act as he surmises, by generating certain organic poisons; if it becomes practicable to isolate these poisons, the chemist will be left master of the field. We may here remark that the author claims for chemists the right to adjudicate concerning the potability of a water. He writes:—"By the logical use of the results obtained from the analysis of waters, combined with a knowledge of their history, it is not difficult for chemists to form a sound judgment as to whether they are or are not fit for drinking use, notwithstanding all that has been said to the contrary by engineers and biologists."

Mr. Kingzett's work is not merely a valuable addition to our sanitary literature: it is a guide-book which we must recommend not only to town councillors, members of local boards, and other municipal bodies, but also to their constituents. A general knowledge of the truths here expounded would have saved not a few towns from costly blunders.

The Retrospect of Medicine: being a Half-yearly Journal containing a Retrospective View of Every Discovery and Practical Improvement in the Medical Sciences. Edited by W. Braithwaite, M.D., and James Braithwaite, M.D. Vol. xc. July to December, 1884.

The amount of matter here of direct chemical interest is not large. A prominent place is due to Prof. Tommasi-Crudeli's paper on the sanitation of malarious districts. This eminent authority lays great weight on deep drainage, so as to prevent soil-water stagnating anywhere near the surface. He points out that already in the last century Lancisi had advocated planting as a remedy for malaria. In the eucalyptus he declares that he has no faith. He cites from his own observation instances in the Roman Campagna, where these trees had been introduced, and where they had for a long period given complete satisfaction, until suddenly, in 1882, a severe attack of malaria occurred; whilst other regions where malaria used to manifest itself were free from the disease. Still he recommends a thorough cultivation of the soil.

There is a short paper, taken from the *Lancet*, on unsuspected cases of lead-poisoning. The author, a country practitoner, residing in a district where the subsoil is sand, and where the water is ferruginous, has detected cases of poisoning which had been mistaken for indigestion, rheumatism, cancer of the stomach, &c. Leaden pipes leading from wells to pumps, or from cisterns to taps, seem, with the water of the district in question, to have been the causes of the mischief. If the time and attention of inventors were not so largely taken up with devising new means of destruction, it might be possible to devise some new and unobjectionable material for water service pipes. Our forefathers, who were content with the draw-well and the old oaken bucket, were free from this insidious inward enemy.

Report of the Commissioner of the Imperial Mint, for the Year ending the 30th of the 6th Month of the 17th Year of Meiji (30th June, 1884). Hiogo: 1884.

In this annual report, which is again before us, we notice but few points of chemical interest. From a financial point of view, however, the statistics that are here given are of a highly instructive character, but lie much out of the sphere of chemists. Considering that the Imperial Mint of Japan gives employment to over seven hundred men, the amount of work connected with the coinage of the country performed during a year must be great, and it is an interesting point for contemplation how long the present rate of operations can continue. In view of this we read that during the past year the number of coins struck reached the enormous total of one hundred and twenty-eight and a half million pieces, representing a value of about five and a-half million yen. Of this vast sumber, however, about one hundred and twenty-five millions were copper pieces.

Several of the chemical operations conducted in this large establishment are apparently increasing at such a rate as may soon render the Japanese race independent of external chemical markets. The sulphuric acid manufactured during the year has increased slightly compared with last year, the total amount made being about four and a-half million pounds of various sorts. The manufacture of sulphate of soda, black-ash, bicarbonate of soda, and caustic soda continues, the production of the latter having gradually increased owing to a change in the operations.

From this report we learn the interesting fact that "William Gowland, Esq., Chemist and Assayer of the Mint, and Robert MacLagan, Esq., Engineer of the Mint, have had the honour to receive the Decoration of the Order of the Rising Sun of the Fourth Class, for their meritorious services during their engagement in the Mint."

Technologisches Wärterbuch in Englischen und Deutschen Sprache. (Technological Dictionary in English and German.) By Gustav Eger. Brunswick: Viewig and Son, 1884. London: Trübner and Co.

This useful volume forms the second part, German-English, of Gustav Eger's Technological Dictionary, revised and enlarged by Otto Brandes, to the first part of which we drew the attention of our readers some little time ago. The work, which contains the terms and locutions employed in architecture, engineering, chemistry, mineralogy, mining, &c., cannot but be of great value to our technologists. We notice that several well-known English Scientific men—Bedson, Carnelley, Hummel, Ward, and Williams—have given their assistance in its compilation.

The interior of this volume seems to be all that could be desired, but we think that a somewhat stronger exterior might have been given to such a work of reference.

CORRESPONDENCE.

THE FUSION AND WORKING OF IRIDIUM.

To the Editor of the Chemical News.

Sir,—We have read with interest the articles on the fusion of iridium, by Mr. Nelson W. Perry, in your issues of 2nd, 9th, and 16th inst. It is only right to record the fact that in the Great Exhibition of 1851 we exhibited a large piece of iridium alloy similar to that patented by Mr. Holland, and that the ready fusion of iridium with phosphorus was a matter of metallurgical knowledge long before such exhibit; in fact, some present members of our staff carry their record of its preparation as far back as 1837.

With regard to pure iridium, its preparation and fusion has been carrred on by us for years, and large masses of it have from time to time been exhibited by us. For instance, one piece of about 65 ozs. was shown by us in the Paris Exhibition of 1867, and again some in a more finished state of preparation in 1878. For many years past we have succeeded in working pure iridium into rods and wire, and have the impression that we presented to yourself some pure iridium wire in a twisted form some years since.

We make these remarks solely with a wish that the historical facts in connection with this interesting metal should be correctly recorded, and not as desiring in any way to detract from the credit due to Mr. Holland and the American Iridium Company for their efforts to develop the use of that metal.—We are, &c.,

Johnson, Matthey, and Co.

London, January 31st, 1884.

[In April, 1882, Mr. Sellon, of the firm of Johnson and Matthey, presented us with a beautiful specimen of pure fused and wrought iridium, in the form of wire, 2 inches long and about 0·05 inch diameter. It has been bent sharply on itself in the middle, and the two ends are twisted together for about half their length. The specimen has been frequently exhibited as a curiosity, and has been admired by everyone as a triumph of metallurgical art. *Ed.* C.N.]

CHEMICAL NOTICES FROM FOREIGN SOURCES.

Note.—All degrees of temperature are Centigrade unless otherwise expressed.

Comptes Rendus Hebdomadaires des Séances, del'Académie des Sciences. Vol. c., No. 3, January 19, 1885.

The Existence of Glycyrrhizine in several Vegetable Families.—E. Guignet.—Glycyrrhizine, or more correctly glycyrrhizic acid, is connected with the principal series of organic chemistry, and seems to play an important part in vegetation.

On Oxygenated Water.—M. Hanriot.—The author has succeeded in distilling oxygenated water under reduced pressure, the quantity passing over being the greater the more concentrated the original liquid. Oxygenated water may be determined quantitatively either by determining directly the volume of oxygen which it can give off, or indirectly by means of standard solutions. The latter process alone is exact. As for the methods which give directly the volume of oxygen liberated, Thénard proposed two, founded on the decomposition of the oxygenated water by heat or by manganese peroxide. The decomposition by heat should be absolutely rejected, for if dilute solutions are thus treated the greater part escapes decomposition. The decomposition with manganese peroxide is likewise incomplete, but the quantity which escapes the action of the peroxide is constant, and is equal to 0·3 volume. Pure hydrogen peroxide is acid. The neutral product obtained by Thénard contained a small quantity of baryta, and was therefore naturally unstable. Oxygenated water conducts electricity better than water, and can therefore be decomposed by the battery without the addition of acid.

Cobalt Peroxide, Co_3O_4.—Alex. Gorgen.—The author has succeeded in obtaining this compound in measurable crystals by submitting the melted chloride to a current of moist air in the apparatus which he used for the preparation of artificial hausmannite.

The Formation of Tetra-methyl-ammonium Nitrate.—E. Duvillier and H. Malbot.—The authors caused methyl nitrate to react at ordinary temperatures upon strong liquid ammonia, stirring daily. At the end of six weeks the methyl nitrate had disappeared. The liquid was then treated with an excess of boiling potassa to expel the volatile ammonias, which were then separated according to the indications of Duvillier and Buisine. The strongly alkaline liquid which remains after the distillation of the volatile ammonias was exactly neutralised with nitric acid. The saltpetre was chiefly eliminated by a number of successive concentrations and crystallisations. The syrupy mother-liquor, on the addition of alcohol, deposited a further portion of saltpetre. The alcoholic liquid, when evaporated to dryness, yielded an abundant residue, which was taken up in absolute boiling alcohol. On cooling, crystals of tetra-methyl-ammonium nitrate were deposited.

Method of Regulating and Measuring the Chemical Action of Radiations.—L. Olivier.

The Origin of the Microzymas and Vibriones of the Air, the Water, and the Soil, with reference to a Memoir by M. Duclaux.—A. Béchamp.—A controversial paper concerning priority.

The Vitality of the Germs of Microbia.—M. Duclaux.—The persistence of life in microbia for twenty or twenty-five years is not rare. Slight alkalinity is more favourable to their preservation than is acidity.

Journal de Pharmacie et de Chemie.
Vol. xi., January 1, 1885.

New Method of Preparing Canquoin's Paste.—M. Balland.—A pharmaceutical paper.

Contributions to the Pharmacological Study of Conium maculatum.—M. Lepage.—A purely pharmaceutical paper.

On Cocaine: Anæsthetic Action of Cocaine Hydrochlorate.—M. Vulpian.—Cocaine, an alkaloid existing in the leaves of *Erythroxylon coca*, has the composition $C_{17}H_{21}NO_4$. It has been introduced into surgical practice as a local anæsthetic.

The Local Anæsthesia of the Eye obtained by the Application of Cocaine.—M. Panas.—Further observations on the same subject.

On Antipyrine.—A medical paper.

Special Review of Pharmaceutical Memoirs Published Abroad.—This summary is taken up with cocaine and antipyrine.

Special Review of Chemical Memoirs Published Abroad.—We have here a notice of new syntheses of the quinoleic derivatives, from the *Berichte der Deutsch. Chem. Gesells.*, and a further communication on antipyrine.

Vol. xi., No. 2, January 15, 1885.

Analysis of a Sebaceous Ovarian Kyste.—C. Méhu.—The bulk of the kyste is a gelatinous matter, different in composition in its different portions. The white globes with which it was interspersed contained in 100 parts of dry matter:—

Fat	31·098
Anhydrous mineral salts	1·901
Epithelial detritus	67·001

The Preparation of Nitrous Oxide.—P. Cazeneuve.—The author raises the questions—What are the circumstances which sometimes occasion explosions in the preparation of nitrous oxide? Why nitrous oxide recently prepared has an irritating odour, and determines cyanosis and symptoms of asphyxia? Why after remaining twenty-four hours in the gas-holder is it modified so as to become softer to breathe? Why after a long stay in the gas-holder does it gradually lose its anæsthetic properties? To the first question the author replies that the explosions in the preparation of nitrous oxide are due to the application of too high a temperature, and not to the presence of ammonium nitrate as an impurity. The irritating odour of recently-prepared nitrous oxide is due to a trace of hyponitrite which escapes absorption in the washing-bottles, but which is removed by prolonged contact with water. The decline of the anæsthetic power following upon prolonged retention in the gas-holder is due to the solution of a part of the nitrous oxide in the water, and the consequent proportional increase of the free oxygen and nitrogen present as impurities. Liquefied nitrous oxide does not contain any of the higher oxides of nitrogen.

Memoir on Wheat-flour.—M. Balland.—The substance of this paper has already appeared in the *Comptes Rendus*.

The Bark of the Cascara sagrada.—M. Limousin.—This bark is said to contain tannin and chrysophanic acid.

On Antiseptics.—M. Ratimoff.—The author gives in the form of tables the proportions of different antiseptics which prevent the development of microbia in organic decoctions.

Decomposition of Iodoform and Calomel on Exposure to Light.—M. Bendiner.—Decomposition takes place at ordinary temperatures on exposure to light.

Preparation of Daturine.—M. Hartz.—From the *Pharmaceutical Journal.*

The Preparation of Marsh-gas.—Dr. Gladstone and A. Tribe.—From the *Journal of the Chemical Society.*

SModifications in the Nutrition of the Nervous ystem produced by Madness, Lypemania, and Epilepsy.—A. Mairet.

Researches on the Biological Function of Phosphoric Acid.—A. Mairet.

Influence of Intellectual Work on the Elimination of Phosphoric Acid in the Urine.—A. Mairet.

Curves of Solubility.—A. Etard.

Portable Electric Lamps.—G. Trouvé.—These last five papers are from the *Comptes Rendus.*

Journal für Praktische Chemie.

New Series, Vol. xxx., Parts 6 and 7.

Electro-chemical Studies.—W. Ostwald.—In this memoir the author discusses the electro-conductivity of acids. His recent experiments confirm the view which he lately advanced of a proportionality between the values of the conductivity and the constants of the rapidity of chemical reactions. All monobasic acids make the impression of a convergence towards the same limit-value of a little above 100 as is shown by the strong acids. The increase of the conductivity of weak acids with increasing dilution takes place the more decidedly the weaker the acid, and this approximately proportional to the square-root of the quantity of water.

Remarks on the Atomic Weight of Bismuth.—R. Schneider.—The mean value appearing from six determinations is 208·16. The author points out the danger of using strongly hygroscopic chlorides—such as those of magnesium, zinc, antimony, bismuth, &c.—as a basis for the determination of atomic weights.

On Gold Purple.—Max Müller.—The author obtains the "purple of Cassius" with magnesia and alumina, as well as with tin or even in superior quality. Not only inorganic but organic substances can be coloured red by means of gold chloride. The colour is determined not by any combination of gold, but by metallic gold in a fine state of sub-division in which it is transparent and transmits merely the red rays. (Hence, contrary to what is sometimes intimated, the production of the purple of Cassius is not a characteristic reaction of tin).

The Derivatives of Methyl-Sulphonic Acid and in particular of Tri-chlor-methyl-sulphon-chloride.—G. McGowan.—The results of this memoir are: methyl-sulphonic acid and dichlor-methyl-sulphonic acid yield with phosphorus pentachloride the corresponding acid chlorides, whilst tri-chlor-methyl-sulphonic acid cannot be transformed into the corresponding chloride. Potassium cyanide does not seem to act directly upon methyl sulphon-chloride. With tri-chlor-methyl-sulphon-chloride it gives tri-chlor-methyl sulphinic acid, with formation of cyanogen chloride. Sulphuretted hydrogen has no reducing action upon methyl-sulphon-chloride in alcoholic solution. Ammonia yields with methyl-sulphon-chloride and dichlor-methyl-sulphon-chloride the corresponding amides; with the trichlor compound it yields no amide, but a reduction product (trichlor-methyl-sulphinic acid) with escape of nitrogen. Aniline yields with methyl-sulphon-chloride and with tri-chlor-methyl-sulphon-chloride the corresponding anilides. Metals act variously upon trichlor-methyl-sulphonic acid; iron forms a tri-chlor-methyl-sulphonate, whilst with zinc there ensues reduction and the formation of dichlor-methyl-sulphonic acid. Hence there is an important difference between tri-chlor-methyl-sulphone chloride and methyl-sulphon-chloride.

The Action of Chlorine upon Ethyl Sulphocyanide.—Dr. J. W. James.—If dry chlorine is passed into pure ethyl sulphocyanide hydrochloric acid is evolved, but not cyanogen chloride gas. If the temperature is kept down crystals are deposited and the liquid turns to an orange-yellow. The crystals formed are solid cyanogen chloride, whilst a fraction of the liquid passing over between 130° to 140° appears to be a dichlor-ethyl-sulpho-chloride. The author is further engaged with the examination of this compound and of the corresponding bromine-products.

The Density of Saturated Solutions of Solids in Water at Different Temperatures.—J. L. Andreae.—

MEETINGS FOR THE WEEK

Monday, 9th.—London Institution, 5.
—— Medical, 8.30.
—— Society of Arts, 8. (Cantor Lectures.) "The Distribution of Electricity," by Prof. George Forbes, M.A., F.R.S.E.
Tuesday, 10th.—Royal Institution, 3. "Colonial Animals," by Prof. Moseley.
—— Institution of Civil Engineers, 8.
—— Royal Medical and Chirurgical, 8.30.
—— Pathological, 8.30.
—— Photographic, 8. (Anniversary).
Wednesday, 11th.—Society of Arts, 8. "Report of the Royal Commission on Metropolitan Sewage," by Capt. Douglas Galton, F.R.S.
—— Geological, 8.
—— Microscopical, 8. (Anniversary.)
Thursday, 12th.—London Institution, 5 and 7.
—— Royal, 4.30.
—— Royal Institution, 3. "The New Chemistry," by Prof. Dewar.
—— Philosophical Club, 6.30.
—— Society of Arts, 8. "Production of Ammonia from the Nitrogen of Minerals," by George Beilby.
Friday, 13th.—Royal Institution, 8. "Forms of Leaves," by Sir John Lubbock, at 9.
—— Astronomical, 3. (Anniversary).
—— Quekett Microscopical, 8.
Saturday, 14th.—Royal Institution, 3. "Operations which go on between Molecules," by G. Johnstone Stoney.
—— Physical, 3. Annual General Meeting.

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THE CHEMICAL NEWS.

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DISCOVERY AND RE-DISCOVERY.

To the man of Science it is a somewhat startling experience to find that the results of his observations, made known to the world years ago, are re-discovered, and published as a novelty without the slightest reference to their origin.

Nearly ten years ago Mr. Crookes suggested the use of the radiometer in photometry, and recommended it to photograpers as a means of timing the exposure of the sensitive plate to light, so as to secure uniformity of action. This proposed application was published in several scientific papers; amongst others in the *Quarterly Journal of Science* for July, 1875, p. 13, in the following passage:—

"By timing the revolutions of the instrument when exposed direct to a source of light—a candle, for instance,—the total radiation is measured. If a screen of alum is now interposed, the influence of heat is almost entirely cut off, the velocity becomes proportionately less, and the instrument becomes a photometer. By its means photometry becomes much simplified; flames the most diverse may readily be compared between themselves or with other sources of light; a 'standard candle' can now be defined as one which at x inches off causes the radiometer to perform y revolutions per minute, the values of x and y having previously been determined by comparison with some ascertained standard; and the statement that a gas-light is equal to so many candles may, with more accuracy, be replaced by saying that it produces so many revolutions.

"To photographers the radiometer will be invaluable. As it will revolve behind the orange-coloured glass used for admitting light into the so-called dark room, it is only necessary to place one of these instruments in the window to enable the operator to see whether the light entering his room is likely to injure the sensitive surfaces there exposed; thus, having ascertained by experience that his plates are fogged, or his paper injured, when the revolutions exceed, say, ten a minute, he will take care to draw down an extra blind when the revolutions approach that number. Still more useful will the radiometer be in the photographic gallery. Placing an instrument near the sitter at the commencement of the day's operations, it is found that, to obtain a good negative, the lens must be uncovered—not for a particular number of seconds, but during the time required for the radiometer to make, say, twenty revolutions. For the remainder of the day, therefore, assuming his chemicals not to vary, the operator need not trouble himself about the variation of light; all he has to do is to watch the radiometer and expose for twenty revolutions, and his negatives will be of the same quality,[*] although at one time it may have taken five minutes, and at another not ten seconds, to perform the allotted number."

He was therefore naturally no little surprised that M. L. Olivier had done him the honour of re-discovering this method, and had communicated it as a novelty to the Academy of Sciences in the following words:—

"*Method for Regulating and Measuring the Chemical Action of Radiations.* By M. L. Olivier.

"The intensity of the various radiations which we receive from the sun varies at every moment on the surface of the earth. Hitherto, consequently, we have not been able to regulate the chemical action of these radiations, nor to appreciate with accuracy the influence which they exert on the phenomena of life.

"For the same reason the arts based upon the chemical action of light are wanting in precision. In photographing landscapes we only succeed in finding the time of exposure by successive approximations. It is the same with the applications of photography to the study of microscopic objects, meteors, &c.

"The author endeavours to suppress these difficulties by employing a method the principle of which is as follows:—If there is given a group of radiations of determined spectral rank, it is required to let equal quantities of it act upon the different substances under examination in order to render the results comparable. He has succeeded in so doing by dispensing with any measurement of the time of exposure, and taking account merely of the mechanical action of the radiations. There is, in fact, a relation between the intensity of the vibrations and the mechanical action which shows its *vis viva*. In order to appreciate it he makes use of the radiometer: in all his experiments the light was let act during one and the same number of rotations of this instrument.

"In order to regulate the action of light upon the salts of silver in presence of organic matters in photographic operations, the author adopts the following arrangement:—In front of the camera he places a radiometer. He encloses it with screens which only allow those vibrations which act upon the sensitive plate to arrive at the radiometer. He notes the number n of rotations which the radiometer performs during the time of exposure which gives a good proof. When this determination has once been made the measurement of time is disregarded. Whenever the light is allowed to act during n revolutions of the radiometer, a proof is obtained identical with the typical proof. If, for instance, it is desired to reproduce a series of designs of the same form, the author fixes successively all the designs at the same place upon a wall, at the same distance from the camera, and exposes each during the very variable time which the radiometer takes to accomplish n revolutions. According as the day becomes gloomier or brighter, the movement of the radiometer is slackened or accelerated. Thus the quantity of light which acts upon the sensitive plate remains unchanged.

"By this means nothing is left to chance: we operate with certainty whatever is the season of the year or the hour of the day, and effect a considerable economy of time and of sensitive plates.

"But from the fact that this method regulates the action of the radiations with a precision amply sufficient for photography, it does not follow that this precision is absolute. The author proposes fixing its degree in order to extend the application of his method to scientific researches.

"As for the measurement of actinic actions it may be effected very exactly by means of the radiometer.

"1. We may employ a group of radiations of a given refrangibility. We receive in succession equal quantities upon substances of different sensitiveness,—*e.g.*, upon two plates, the one with moist collodion, and the other with the gelatino-bromide of silver. The opacities thus produced upon the two plates by the decomposition of the salts of silver are very different. To express their relation it is sufficient, as M. Jansen has shown, to have recourse to known photometric procedures.

"2. We may also impress the different parts of one and the same photographic surface by causing the light to act upon them for n, n', n'', n''', ... revolutions of the radiometer, Photometry shows the relation of the effects produced, whence the possibility of expressing the relation existing between these effects and the corresponding quantities of light.

"As it will be seen, this method does not merely interest the photographer. The author reserves to himself to determine the conditions in which it may be legitimately

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"[*] In this brief sketch I omit reference to the occasions in which the ultra violet rays diminish in a greater proportion than the other rays."

used for studying, with more precision than has been hitherto practicable, certain questions relating on the one hand to photography, and on the other to the influence of light upon living beings."—*Comptes Rendus.*

The reader will at once perceive that the essential ideas of M. Olivier's memoir, though clothed in different language, are distinctly the same as those put forward ten years ago in the above-quoted extract from the *Quarterly Journal of Science.*

Mr. Crookes is, of course, duly sensible of the honour done him by this confirmation of his former results; but he is entitled to doubt whether such a re-publication of matter already known to the world is worthy of being laid before a body so illustrious as the Academy of Sciences.

THE VOLUMETRIC DETERMINATION OF NITRIC ACID.

By ANTONIO LONGI.

E. Kopp makes use of diphenylamine not merely for the recognition of nitrous acid in commercial sulphuric acid, but for its colorimetric determination. This elegant and easy method is, however, only adapted for the technical examination of sulphuric acid.

The author has shown, in an earlier memoir, that nitric acid in an aqueous solution, whether free or combined, may be detected by means of diphenylamine, even when diluted with 1,500,000 parts of water. Having observed that salts of tin cause the blue colour produced by diphenylamine to disappear, he proposes to utilise this fact for the volumetric determination of nitric acid.

The salt of tin employed is the potassium stannous sulphate of Marignac. He adds 40 grms. of this salt to 800 c.c. of sulphuric acid free from nitric acid, and diluted with an equal volume of water. He effects the perfect solution of the salt by the addition of a minimum of strong hydrochloric acid. The solution is then titrated according to the method of R. Fresenius (*Zeitschrift Anal. Chemie.*, i., 26), and so much dilute sulphuric acid is added that the solution contains 0·0118 grm. tin (as stannous oxide) per c.c. This decinormal solution is preserved in the apparatus recommended by R. Fresenius for stannous chloride.

To certain volumes of a titrated solution of potassium nitrate, kept cool in the water-bath, the author added 2, 3, 3·5, and 4 volumes of pure sulphuric acid. To each of these mixtures, when cold, he added a single drop of diphenylamine sulphate, when they assumed an intense blue colour. Into each the decinormal tin solution was was then dropped from a burette graduated into tenths of c.c. The following results were observed:—

1. In the liquids to which only 2 volumes of sulphuric acid had been added, the blue colour disappeared immediately on the first addition of the tin-solution, but returned after a time, disappearing and returning on further additions of tin, until it finally disappeared, and the liquid remained permanently yellow.

2. In the liquids to which 3 to 4 volumes of sulphuric acid had been added, the blue colour remained so long as the tin-solution added did not exceed a certain limit, when the reappearance of the colour was no longer possible.

3. In either case, for equal quantities of nitrate, equal quantities of tin-solution were necessary to effect the final disappearance of the blue colour.

From these experiments it was found possible to determine the quantity of nitric acid by the quantity of the decinormal tin-solution used, 4 mols. of the salt corresponding to 1 mol. of nitric acid.

The results obtained are exceedingly satisfactory. The author hopes that this method may be favourably received on account of its speed and its accuracy, and may especially find application in cases where very small quantities of nitric acid have to be determined.

In presence of small quantities of ferric salts, the number of c.c. of the decinormal solution consumed must be diminished by the number of c.c. corresponding to quantity of ferric salts present. If ferric salts are present in relatively large proportions the results are quite erroneous. A hydrochloric solution of stannous chloride cannot be employed in place of the potassium stannous sulphate.—*Zeit. f. Anal. Chem.*

ABSOLUTE ETHER.

(Concluded from p. 69).

Fuchsine is stated to be a critical test for alcohol and water in ether. If a very minute quantity of powdered fuchsine be shaken with a considerable quantity of ether, the ether remains colourless if quite free from alcohol and water, but takes a pink tint, the depth of which is proportionate to the alcohol and water present.

In the application of this test it is first necessary to discriminate between the fuchsine of the market. Both acetate and hydrochlorate of rosaniline are sold as fuchsine. The acetate is in large crystalline fragments, while the hydrochlorate is in small nacreous tables, both of a beautiful green colour. The acetate is the appropriate salt for this testing. It is, however, not a test for alcohol at all. Increasing proportions of nearly water-free alcohol up to about 0·2 p.c. may be added to a nearly water-free ether without increasing the depth of the tint from fuchsine. For water the fuchsine seems to be a very sensitive test indeed, when very carefully applied, but such critical application is attended with some difficulties. The acetate of rosaniline should be used in fine powder. Being somewhat hygroscopic it takes a little moisture from the air in powdering, even if powdered in a warm mortar, quickly, and in a moderately dry air. If the powder has any accidental moisture,—and a little is unavoidable,—this, with its dissolved acetate, will be taken by the ether, even though this latter might have been water-free, and will communicate a tint. Again, if the test-tube or flask in which the ether and the acetate be shaken together contain much moist summer air, it will supply moisture enough to give a tint, or increase that from other sources. The tube or flask should be nearly filled up with the ether, and the depth of tint should be compared with a similar flask or tube similarly filled with the ether without the acetate, and the two should be looked at side by side against white paper. The writer has as yet seen no ether that did not give a perceptible tint under this management, when very closely scrutinised, and this is not remarkable in association with the fact that one milligrm. of acetate of rosaniline gives a similar faint tint to ten litres of colourless distilled water. By calculation this would indicate the presence of about 0·001 p.c. of water, a proportion almost unavoidably carried to the ether by the acetate and the air in the testing.

Ether which stands this test in this way will bear the addition of nearly 0·2 p.c. of absolute alcohol of a sp. gr. of 0·79356 at 15·6° C., compared with water at the same temperature as unity, without distinctly deepening the tint. But if the alcohol added has a higher density the tint will be proportionately deepened by it.

The critical test for alcohol in ether is that of Lieben as modified by Hager. This test is based on the statement that in the presence of iodine and an alkali every trace of alcohol present will be converted into iodoform, which iodoform will separate out in the characteristic form of its yellow crystals. But in order to be very critical this test has to be most carefully guarded, and even then its applicability to ether is doubtful. It cannot be applied

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* From "An Ephemeris of Materia Medica, Pharmacy, Therapeutics, and Collateral Information." By Edward R. Squibb, M.D., Edward H. Squibb, S.B., M.D., and Charles F. Squibb, A.B.

ETHER TABLE.

Table of specific gravities of combinations of absolute ether and alcohol; the ether having a sp. gr. of 0·71888, and the alcohol of 0·82012, both liquids at 15° C. = 59° F. compared with water at 4° C. = 39·2° F. as unity. Or, the ether of 0·71890, and the alcohol 0·82016, both liquids at 15·6° C. = 60° F., compared with water at 15·6° = 60° F. as unity. This table is trustworthy to the third decimal place, and moderately accurate to the fourth. The corrected columns are corrected for the expansion of glass only.

P.c. by Wt.	COMPARED WITH WATER AT 4° C. = 39·2 F. AS UNITY.							COMPARED WITH WATER AT 15·6° C. = 60° F. AS UNITY.		
		Weighed at—							Weighed at—	
	4° C.=39·2 F.	15° C. = 59° F.		15·6°C. = 60° F.		25° C. = 77° F.		15·6° C. = 60° F.	25° C. = 77° F.	
	True.	Apparent.	Corrected.	Apparent.	Corrected.	Apparent.	Corrected.	True.	Apparent.	Corrected.
100	0·73128	0·71908	0·71888	0·71838	0·71817	0·70788	0·70751	0·71890	0·70842	0 70825
99	0·73257	0·72040	0·72020	0·71969	0·71948	0·70923	0·70886	0·72021	0·70975	0·70958
98	0·73386	0·72172	0·72152	0·72101	0·72080	0·71057	0·71020	0·72152	0·71108	0·71091
97	0·73415	0·72205	0·72185	0·72233	0·72212	0·71192	0·71155	0·72284	0·71241	0·71224
96	0·73644	0·72438	0·72418	0·72364	0·72343	0·71326	0·71289	0·72416	0·71374	0·71357
95	0·73764	0·72564	0·72544	0·72490	0·72469	0·71457	0·71419	0·72541	0·71506	0·71489
94	0·73884	0·72690	0·72670	0·72616	0·72595	0·71589	0·71551	0·72666	0·71638	0·71621
93	0·73904	0·72814	0·72794	0·72742	0·72721	0·71721	0·71683	0·72792	0·71770	0·71753
92	0 74124	0·72938	0·72918	0·72868	0·72847	0·71852	0·71814	0·72918	0·71902	0·71885
91	0·74225	0·73064	0·73044	0·72994	0·72973	0·71982	0·71944	0·73043	0·72033	0·72016
90	0·74366	0·73190	0·73170	0·73121	0·73100	0·72113	0·72075	0·73168	0·72164	0·72147
89	0·74487	0·73215	0·73195	0·73248	0·73227	0·72245	0·72207	0·73298	0·72295	0·72278
88	0·74608	0·73440	0·73420	0·73374	0·73353	0·72374	0·72336	0·73428	0·72426	0·72409
87	0·74728	0·73557	0·73537	0·73494	0·73473	0·72495	0·72457	0·73547	0·72547	0·72530
86	0·74847	0·73674	0·73654	0·73614	0·73593	0·72617	0·72579	0·73666	0·72669	0·72652
85	0·74968	0·73791	0·73771	0·73734	0·73713	0·72739	0·72701	0·73785	0·72791	0·72774
84	0·75086	0·73908	0·73888	0·73854	0·73833	0·72860	0·72822	0·73904	0·72912	0·72895
83	0·75193	0·74028	0·74008	0·73974	0·73953	0·72982	0·72944	0·74022	0·73034	0·73017
82	0·75299	0·74149	0·74129	0·74095	0·74074	0·73103	0·73065	0·74141	0·73156	0·73139
81	0·75406	0·74270	0·74250	0·74216	0·74194	0·73224	0·73186	0·74260	0·73278	0·73261
80	0·75512	0·74390	0·74370	0·74336	0·74314	0·73346	0·73307	0·74378	0·73400	0·73383
79	0·75634	0·74508	0·74488	0·74453	0·74431	0·73469	0·73430	0·74495	0·73523	0·73506
78	0·75756	0·74627	0·74606	0·74570	0·74548	0·73592	0·73553	0·74612	0·73645	0·73628
77	0·75878	0·74746	0·74725	0·74687	0·74665	0·73715	0 73676	0·74729	0·73767	0·73750
76	0·76000	0·74864	0·74843	0·74804	0·74782	0·73838	0·73799	0·74846	0·73890	0·73873
75	0·76127	0·74991	0·74970	0 74934	0 74912	0·73970	0·73931	0·84975	0·74022	0·74005
74	0·76255	0·75119	0·75098	0·75063	0·75041	0·74102	0·74063	0·75104	0·74154	0·74137
73	0·76383	0·75247	0·75226	0·75193	0·75171	0·74234	0·74195	0·75233	0·74286	0·74269
72	0·76510	0·75374	0·75353	0·75322	0·75300	0·74366	0·74327	0·75362	0·74418	0·74401
71	0·76640	0·75504	0·75483	0·75452	0·75430	0·74501	0·74462	0·75492	0·74548	0·74530
70	0·76770	0·75634	0·75613	0·75582	0·75560	0·74635	0·74596	0·75623	0·74687	0·74669

directly to the ether for reasons that are obvious. The ether, say 20 c.c. of it, must be well and thoroughly shaken with 10 c.c. of distilled water, and the water be separated for the testing. Now if ether in the presence of water regenerates traces of alcohol, as is said on good authority to be the case, it is difficult to see how this water, with which the ether is washed for the testing, can be free from traces of alcohol, even though no alcohol was previously present in the ether. The writer has seen his absolute ether so stand this test as to leave it very doubtful whether a trace of iodoform was or was not formed, after many repetitions, but has never seen it unmistakeably absent. The test is best applied as follows:—

To the 10 c.c. of washing water 3 or 4 drops of a 10 p.c. solution of caustic potassa are added. Then a solution of iodide of potassium saturated with iodine is added until the solution is rather deeply coloured by it. Finally, solution of potassa is again added until the liquid is decolourised. The result is never entirely negative, though at times the precipitate is so scanty as to be hardly perceptible until after the lapse of several hours. The precipitate is then examined with a good glass, when yellow crystals will be found among the particles. With the same materials this test varies considerably from some causes not ascertained, but so far the writer has not failed to find minute microscopic yellow crystals supposed to be iodoform.

It is stated by many authorities that absolute ether is soluble in water in the proportion of one volume in ten of water, but this is a current mistake. Even at a temperature of 25° C. one volume requires 11·1 volumes of water for solution.

When 15 c.c of the ether and 15 c.c. of water are shaken together at 25° C., there is a contraction of volume to about 29·8 c.c., the ethereal stratum measuring 15 c.c., and the water 14·8 c.c. This ether saturated with water is rendered very decidedly pink in tint by fuchsine.

A prominent object in obtaining absolute ether is that it forms a standard by which to compute, with a practical degree of accuracy, the strength of the higher grades of ether which are not absolute, and the ether obtained by the writer, if not entirely absolute, is near enough for all practical purposes. By the large apparatus and management described, a very uniform product having an apparent sp. gr. at 15° C .of 0·72450 compared with water at 4° C. is obtained as before stated, and this ether by all the tests proves to consist of about 95·9 p.c. absolute ether, and 4·1 p.c. of alcohol which contains a small proportion of water. The strength of this 4·1 p.c. of alcohol was not accurately determined, but it was estimated to be about 90·75 p.c., corresponding to a sp. gr. of 0·820 at 15° C.

This would give for the composition of such an ether the following formula:—

Absolute ether		95·9 p.c.
Absolute alcohol	3·72	
Water	0·38	4·1 p.c.
		100·0 p.c.

This is believed to be sufficiently accurate for all practical purposes, and moreover, it is believed to be about the strength of the alcohol which distils over with the ether for all the strengths of ether which are above 88 p.c. The lower the strength of the ether distilled the lower will be the strength of the alcohol which goes over with it, so that the proportion of water constantly increases from absolute ether to the lowest dilution. This proportion of water increases very slowly down to the range of about 88 p.c., but then increases more rapidly down to 80 p.c. and more rapidly still down to 70 p.c. The total increase, however, did not appear to be so great as to seriously interfere with the construction of a table which, without any pretensions to scientific accuracy, might still prove to be very useful. Such a table has been constructed, and is offered herewith.

The absolute ether actually obtained by the writer is the basis of this table, and the specific gravities were taken by means of the flask illustrated at page 9. For diluting the ether an alcohol was prepared of a sp. gr. of 0·82012 at 15° C., water at 4° C. being taken as unity, or 0·82016 at 15·6° C., compared with water at 15·6° C. as unity, such alcohol corresponding very closely to 90·75 p.c. absolute alcohol and 9·52 p.c. water. No attempt was made to reduce the strength of this alcohol for the weaker dilutions,—first, because the rate was not known, though known to be small; and secondly, because the alcohol unavoidably grew weaker as the dilutions and weighings proceeded, by the abstraction of moisture from the summer atmosphere.

From this it may be seen that no such table can be very accurate, and this is the probable reason why such tables have not before been made. But for those who have much to do with ether, a table of even a fair degree of practical accuracy is far better than none at all; and since the number of those who handle and use ether is constantly and rapidly increasing, and will increase more rapidly still as it is more cheaply produced and its uses extend, such tables will become more and more useful.

The dilutions for the table were commenced with the absolute ether of this writer, and carefully adjusted alcohol of 0·82016, but from shaking together, and from other exposure to moist air, both the ether and the alcohol of the mixtures became slowly weaker throughout the range of the table, and no attempt was made to prevent this, from considerations mentioned above. Dilutions were made and accurate specific gravities taken for each difference of 2 p.c. down to 88 p.c., and below that for each difference of 4 p.c., all the other specific gravities being supplied by interpolation. And as with alcohol so with ether, two standards of unity are in common use, specific gravities are given by both these standards,—namely, water at 4° C. and at 15·6° C.

PROCEEDINGS OF SOCIETIES.

CHEMICAL SOCIETY.

Ordinary Meeting, Thursday, February 5, 1885.

Dr. W. H. Perkin, F.R.S., President, in the Chair.

Messrs. J. B. Wallard, Frank Broughton, Rev. Dr. Eley, C. C. Hutchinson, Herbert Jackson, and C. E. Hutchinson were formally admitted Fellows of the Society.

Certificates were read for the first time in favour of Messrs. Edward Greenhill Amphlett, M.A., Woodside, Clewer, Windsor; Robert Gordon Blaine, B.E., Ridley Road, Forest Gate, E.; Frederick Mark Davies, 3, Glenmohr-Terrace, Blackheath; Ernest Howard Farmer, 135, Dulwich Road, S.E.; Charles Watson, 5, Paradise Row, Stockton-on-Tees; Alfred Henry Knight, 321, Upper Parliament Street, Liverpool; Joseph Marshall Stocks, Edenfield, Bury, Lancashire.

The following were elected Fellows of the Society:—Messrs. William Lane Clark, John Norman Collie, Augustus E. Dixon, George Embrey, Arthur George Green, George G. Henderson, George Selkirk Jones, Walter Frederick Parkhurst, Franz Rindskoff, Harold White, Henry B. Whitehead, Alfred C. Wilson, William Albert Wrenn, Alfred C. Young.

A Lecture was then delivered—

"*On Chemical Changes in their Relation to Micro-Organisms.*" By Professor Frankland, D.C.L., LL.D., F.R.S.

A plant being defined as an organism performing synthetical functions, or one in which these functions are greatly predominant; an animal as an organism performing analytical functions, or one in which these functions greatly predominate: the micro-organisms were classed by the lecturer among animals. Their life essentially depends upon the taking asunder of more or less complex compounds, resolving them into simpler compounds at the expense of potential energy.

As micro-organisms are commonly termed "ferments," and their analytical operations "fermentations," it is necessary to sharply distinguish between organised ferments and certain bodies which bring about analogous chemical changes, but which are not only not organised, but exist in solution. These latter, or "soluble ferments," as they are commonly termed, are said to act by contact: they produce certain chemical changes in the fermentescible substances without themselves furnishing from their own substance any of the products of change; the effects they produce are essentially analytical, consisting in the assimilation of water and the splitting up of the fermentescible substance into two or more new molecules, and may be brought about by purely chemical means. They differ only, or chiefly, from the organised ferments in that they are unorganised, and do not increase in amount during their action upon fermentescible substances, of which a very large, although limited, quantity may undergo transformation by the action of a very minute quantity of the ferment. A list of changes brought about by unorganised ferments is given.

In that portion of the animal kingdom with which we are best acquainted, oxidation is the essential condition of life: it is the kind of action by which the animal changes actual into potential energy. The changes effected by micro-organisms are essentially of the same character as those brought about by the higher orders of animals: that is to say, they are all changes by which potential becomes actual energy. With one or two exceptions, the chemical changes effected by micro-organisms—unlike those produced by soluble ferments—cannot be brought about by other means. The observations of Hatton and others have shown that micro-organisms retain their vitality in presence of a variety of substances, which rapidly prove fatal to higher animals; the unexpected fatal effects of spongy iron would seem to promise, however, that there are substances fatal to bacterial life which have no toxic effect on more highly organised animals. It has not yet been shown that any degree of cold, however intense, is fatal; animation may be suspended, but it is restored when the temperature rises. With regard to heat, the lowest fatal temperature recorded is 40° C., but many species can withstand much higher temperatures. Chloroform and compressed air are said to arrest their action, but to have no influence in preventing the changes brought about by unorganised ferments. The position of micro-organisms in nature is only just beginning to be appreciated; their study both from chemical and biological points of view is, however, of the highest importance to the welfare of mankind, and leads the inquirer right into those functions of life which are still shrouded in obscurity.

In the course of the lecture the best known micro-organisms and the chemical reactions due to them were passed in brief review.

Prof. Frankland also referred to the following results of an experiment made in the month of June, in which

	Residue left on evaporation, and drying at 100° C.	Organic Carbon.	Nitrogen as Urea and other Organic Matter.	Ammonia.	Microscopical observations.
Fresh urine	4817·0	943·81	1080·27	142·40	No bacilli.
,, ,, after 1 day ..	—	940·46	1095·05	136·65	,,
,, ,, ,, 3 days ..	—	928·76	1106·70	136·50	,,
,, ,, ,, 5 ,, ..	—	882·66	983·26	288·55	Sparse bacilli.
,, ,, ,, 7 ,, ..	—	739·82	900·80	338·60	
,, ,, ,, 9 ,, ..	—	682·99	784·93	485·12	Numerous bacilli.
,, ,, ,, 11 ,, ..	—	621·02	744·64	534·80	Very numerous bacilli.
,, ,, ,, 14 ,, ..	—	559·22	481·49	870·62	Vast numbers of bacilli.
,, ,, ,, 16 ,, ..	—	530·68	492·04	881·87	Mostly still.
,, ,, ,, 18 ,, ..	—	487·01	355·25	990·78	,, ,,
,, ,, ,, 21 ,, ..	—	466·43	278·22	1105·75	All dead or still.
,, ,, ,, 23 ,, ..	—	451·43	347·45	1017·25	,, ,,
,, ,, ,, 25 ,, ..	2718·0	460·78	283·90	1070·50	
After allowing for evaporation	2045·5	346·77	213·66	805·63	

fresh urine was allowed to stand for 25 days in a clean glass vessel.

The results of these observations and determinations which were made during the month of June show conclusively that, previously to the development of *Bacillus ureæ*, the chemical composition of the urine remained practically unchanged; but with the appearance of micro-organisms, a diminution of organic carbon, and a transference of nitrogen from the organic to the ammonia column, immediately began. As regards rapidity this change marched *pari passu* with the density of population, and reached its maximum about the 12th day; for during the three days (11th to 14th) nearly 10 per cent of carbon disappeared, whilst more than 85 per cent of the organic nitrogen became ammonia. After the 14th day the rate of change became much slower, on the 18th day the bacilli were mostly either dead or motionless, whilst on and after the 23rd day no more moving bacilli were seen. Altogether the quantity of carbon converted into carbonic anhydride, after allowing for concentration of the liquid by evaporation, amounted to 597·04 parts per 100,000 of liquid, or 63·3 per cent of the total quantity; whilst the quantity of organic nitrogen converted into ammonia was 546·19 parts per 100,000, or 50·6 per cent of the whole. These proportions show that all the organic nitrogen contained in the urea was not converted into ammonia. It no doubt escaped as free nitrogen, in accordance with Frank Hatton's observation.

In the original urine the proportion of organic carbon to organic nitrogen was as 1 : 1·15, whilst, after the action of the bacilli, it was as 1 : 0·62.

Prof. Burdon Sanderson said that the main difficulty met with in studying the effects of micro-organisms arose from the fact that it was always difficult and often impossible to distinguish between different organisms. Chemists might naturally turn to biologists for aid in the matter, but biologists must admit the existence of this difficulty. We are fully acquainted with the life-history of only one pathogenic organism—the *Anthrax bacillus*; of this, thanks to Koch, we know, however, a great deal. The method followed by biologists in studying pathogenic forms was, in the first instance, to prepare a pure cultivation of the organism, and then to obtain the proof that the organism produces its proper effect when transferred to a living animal. The morphological relations of bacteria with plants could not be questioned, but he thought it was really of little consequence for practical purposes whether ferment organisms were regarded as animals or plants; what we want to know is, what are the conditions under which an organism is produced, and its life history? He was in the habit of calling them microphytes, as being a neutral term.

Prof. Ray Lankester was astonished at the definite way in which Prof. Frankland had classed the ferment organisms with animals. Naturalists were led to regard them as plants from examining their relations to other organisms. He agreed with Prof. Sanderson that "microphyte" was a good name for them, although not precisely for the same reason, but because it really meant a little plant. He stated that it was held hitherto that a micrococcus induced the ammonic change in urine, and not a bacillus as figured by the lecturer. For the purpose of chemical investigation it was essential to have a pure cultivation. It was curious that the nitrifying organism had not been isolated; its presence had only been inferred, and it had never been satisfactorily separated and identified, although inconclusive statements and observations purporting to inform us as to the form of that organism had been published.

Dr. Brunton said that it was highly probable that the symptoms occurring in certain diseases were due to poisons formed by the action of organisms and not directly to the organisms themselves. This was not improbably the case in cholera. Micro-organisms may even produce substances fatal to themselves, *e.g.*, phenyl compounds. This is also the case with higher organisms, the retention of the urine in man being often attended with fatal results. Although cholera was very probably due to the presence of low organisms, the symptoms were so very like those produced by certain poisons that it was very difficult to diagnose cases of poisoning by arsenic from cholera cases. The cholera poison was probably of an alkaloidal character and related to the ptomaines. Pepsin converted albumenoids into peptones, but it was important to note that Brieger had observed that sometimes an alkaloid having an action similar to curare was formed during peptic digestion, and an alkaloid having a similar action had been obtained from human urine. These facts rendered it probable that alkaloids might be formed in the intestinal canal and absorbed into the general circulation.

Prof. M. Foster said that the question whether the micro-organisms in question were plants or animals was to him a matter of indifference compared to the question—what was the exact nature of the action by which the organism effected the chemical change? He desired to point out that in certain cases, as in the ammonic conversion of urea, the same change, in this case the conversion of urea into ammonium carbonate, was effected, on the one hand, by micro-organism, a micrococcus or bacillus, and on the other hand by an unorganised ferment. His friend, Mr. Sheridan Lea, informed him that he had evidence of both these causes of ammonic conversion of urea. Now, was the action in both cases the same? The idea had naturally occurred that the organism produced its effect by producing an organised ferment. But all attempts to prove the production of such a secretion, so to speak, of a ferment had failed. If such a ferment were produced, it was destroyed or disappeared during its action, whereas ordinary unorganised ferments such as pepsin, &c., were not destroyed at all during their activity, or were destroyed very slowly. On the whole, the probability was that the micro-organism and the unorganised ferment produced the same result in different ways; ought not that *difference* to offer the key for solving the problem?

He further desired to remind the Fellows that actions similar to those of these micro-organisms were continually being carried on by the constituent elements of man and other macro-organisms, and would wish, in illustration, to call their attention to the act of secretion by a secreting cell, such as the pancreatic cell. We had evidence that certain constituents of pancreatic juice existed in the cell, not in the form in which they appear in the juice itself, but in an anterior more complex condition. Thus trypsin occurs in the pancreatic cell not as trypsin but as trypsinogen. Now this trypsinogen, and also probably other "mothers" of the constituent of the juice, exist in the protoplasm of the cell as *discrete granules, lodged in the meshes of the protoplasm, separated from the protoplasm by films of fluid.* Yet the protoplasm, stirred by some nervous impulse, is able to produce a change in these granules, so that they are discharged to form the secretion. How does the protoplasm work upon these granules? Does it discharge something into the fluid of its meshes, which something acts upon the granule, or does it work upon the granule through the film of fluid surrounding the granule, by something which is a sort of "action at a distance." The action then in this case is very comparable to the action of the micro-organisms in question. It is for the chemists to throw light on the exact nature of the changes produced, and when this is done, we may hope to learn how the change is brought about, but not until this is done.

Mr. Thiselton Dyer said that from the botanist's point of view he was struck with the universality of fermentative changes. Though they were so predominant a feature in the life of the lower plants, this was only an extreme manifestation of what, perhaps, all plants were capable of, if the conditions demanded it. Thus Pasteur, following up an experiment of Bérard's, found that a rhubarb leaf in an atmosphere of carbon dioxide yielded after forty-eight hours, though apparently unchanged, small quantities of alcohol. The breaking up of molecules of large thermic equivalent into those of less, supplies the energy needed for the continued life of the tissues, and is the *raison d'etre* of the process.

But plants also set up fermentative changes external to themselves, as it were incidentally and without any obvious benefit. The investigation of Beyerinck on the production of gum by plants yielded most remarkable results. It is due to a disease which is highly contagious, and which is caused by a fungus (*Coryneum*). This produces a ferment which changes the cell-walls into gum. But what is most remarkable is that even after the disappearance of the fungus which initiated the changes, the cells of the host plant take on a morbid habit of growth, and themselves continue the production of the ferment and therefore of gum to their own hurt. The problem is here of the most complicated kind.

The series is ended by cases such as that of *Withania coagulans* (and many others are now known), where plants throw off as by-products of their metabolism, ferments as effective as rennet, without deriving any perceptible advantage from their possession. That plants use in working up their reserve-proteids proteolytic ferments just as animals do, cannot be doubted. But even these they occasionally, as in the Papaw, produce in utter disproportion to their own possible requirements.

Mr. Warington said with regard to the difference between animals and plants, he thought the fact had been somewhat overlooked that plants are able to obtain their nitrogen from such simple compounds as ammonia and nitrates, whereas animals appear to require to have the nitrogen presented to them in an albumenoid form.

As to the nature of the nitrifying organism, Müntz and Schlösing claim to have isolated it and have described it. A friend who had microscopically examined his purest cultivations at Rothamsted, had been unable to find bacilli but they appeared to contain a microccoccus. [Professor Lankester, interposing, remarked that the growth sent to him by Mr. Warington consisted of bacilli, and nothing else.] In explanation, Mr. Warington said that in one of his earlier papers he had mentioned that white films appeared on some of his solutions. Prof. Lankester had examined these, but he had since found that the bacilli of which they consisted were incapable of nitrifying ammonia. Latterly he had followed Dr. Klein's method, and had introduced the infecting matter into the sterilised cultivation liquid by means of a capillary pipette, which was pushed through the cotton-wool plug closing the tube or flask; since he had done this, the films referred to had never been formed.

Dr. Thudichum agreed that the ammonic change was produced in urea by a micrococcus. The study of microphytes and of the chemical changes produced by them in the human body and in the bodies of animals was of the greatest importance. He questioned whether their action was always so specific, however, as was commonly supposed. He would also call attention to the fact that one micro-organism will kill another: thus, after plastering wine, in consequence of the removal of the tartrate, the microphyte which produces ropiness is crowded out by alcoholic forms.

Dr. Stevenson called attention to the importance of obtaining more information as to the alkaloidal bodies formed by the action of micro-organisms.

Prof. Frankland replied that he did not mean absolutely to say that in his experiments the work was done by the *Bacillus ureæ*, but the diagram was a faithful representation of what he saw: he attributed the action to the particular organism, because it commenced when the organism appeared, and ceased when the bacilli became motionless. The necessity of studying the actions of pathogenic organisms had been prominently brought forward in the discussion. He thought there was a substantial difference between the class of chemical changes effected by plants on the one hand and by animals on the other; animals more particularly consumed as food those compounds in which much energy was stored up.

At the next meeting of the Society on Thursday, February 19th, the following papers will be read:—

"On Ethylic Benzoylacetate and some of its Derivatives." Part II. By Dr. W. H. Perkin, Junr.

"On Toughened Filter Papers." By E. E. H. Francis.

"The Detection and Estimation of Iodine." By Ernest H. Cook.

"Note on Methylene Chlor-iodide." By Prof. J. Sakurai.

"A Quick Method for the Estimation of Phosphoric Acid in Fertilisers." By J. S. Wells.

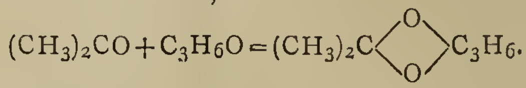
UNIVERSITY COLLEGE, LONDON,

Chemical and Physical Society.

Thursday, February 5, 1885.

C. E. Cassal, F.I.C., F.C.S., President, in the Chair.

Mr. A. G. Green read a paper by himself and Dr. H. F. Morley, on "*Propylene Chlorhydrin, and the Action of Zinc Ethyl on its Benzoate.*" In addition to what they have already published on the subject (Chemical News, vol. li., p. 46), the authors stated that they had heated propylene oxide and acetone in a sealed tube to 300°, hoping to effect the synthesis of a ketate,—



$$(\mathrm{CH_3})_2\mathrm{CO}+\mathrm{C_3H_6O}=(\mathrm{CH_3})_2\mathrm{C}{<}{}^{\mathrm{O}}_{\mathrm{O}}{>}\mathrm{C_3H_6}.$$

On opening the tube, however, its contents were found to be wholly unchanged. Neither did they succeed in obtaining the above compound by heating propylene glycol with acetone, even in the presence of weak dehydrating agents.

Mr. John Buchanan next read a short note "*On a Simple Form of Polariscope.*" The incident light falls on the under surface of a piece of plate-glass inclined at the polarising angle. After inflexion the beam falls perpendicularly on a piece of plane silvered mirror and glass, from which it is reflected upwards back to the polariser, which now serves as an analyser. A piece of strained glass or a quartz plate, placed on the mirror-glass, shows the colours proper to a plate of double the actual thickness.

Samuel Rideal, *Hon. Sec.*

MOSCOW SOCIETY OF FRIENDS OF NATURAL SCIENCES.

Physico-Chemical Section.

The following communications have been made:—

(1). By J. Nikitinsky, "*On various Experiments for the Determination of the Percentage of Ashes in Tea,*" the result of which affords a new confirmation of the statement made by Wigner in 1874, and afterwards corroborated by other experimenters, viz., that the finer sort of tea contains a less amount of ashes than the lower descriptions. In six different kinds of tea, beginning with the dearer kinds and ending with the cheaper qualities, he found from 5·60 to 6·869 per cent ashes. Further experiments with the tea known in Russia as the "Karper" tea, containing an admixture of the leaves of *Epilobium augustifolium*, showed 7·868 and 10·428 per cent ashes. Such an adulteration of tea can therefore easily be determined by ascertaining the amount of ashes.

(2). By W. Rudnev, "*On the Use of Phenol-phthalein for the Determination of Acetic Acid in Tar-Water.*" By this indicator the amount of acid in the water can easily be found out when diluted with from ten to twenty times as much water, and added to a baryta solution. By this simple process the quantity of lime necessary for the saturation of the tar-water in the various branches of manufacture may easily be ascertained. Rudnev further remarks that the water used for washing petroleum-gas contains no traces whatever of the rhodan combinations, and thus explains the absence of sulphur in petroleum-gas, viz., almost the whole sulphur present in the raw petroleum remains in the heavy oils formed in the process of gas manufacture.

(3). In conclusion, V. Markownikow gave some facts with regard to an analysis made by him of some manna found in considerable quantities in the Turkestan district, the inhabitants of which use it partly as a substitute for sugar. The sugar-like substance contained in it seems to be saccharose.

NOTICES OF BOOKS.

A Dictionary of Medicine: including General Pathology, General Therapeutics, Hygiene, and the Diseases peculiar to Women and Children. By Various Writers. Edited by Richard Quain, M.D., F.R.S. London: Longmans and Co.

We have here a new edition of an important work, brought up, it is to be presumed, to the present state of knowledge. The larger part of the subjects here discussed do not fall within our competence. There is, however, no small amount of matter of more or less direct chemical interest. The article on "Albuminuria" contains a fair account of the precautions necessary in applying the ebullition, and the nitric acid tests to urine supposed to contain albumen. As additional tests potassium ferrocyanide, followed by acetic acid, and sodium pyrophosphate are recommended.

Under the head "Alcohol," particular attention is drawn to the deleterious effects of fermented or distilled beverages containing amylic alcohol (fusil). It is recognised that wines "fortified" with the spirit obtained from potatoes possess this objectionable property, and that even those made from must to which potato glucose has been added are likewise tainted.

Under "Aniline Poison" we find the assertion that stockings and gloves, when dyed with aniline colours, "are apt to produce an intense form of inflammation and vesication of the skin which is rebellious against treatment and liable to relapse for many months after the original attack has subsided." Here the question may be raised whether the symptoms indicated are due to the aniline colours as such, to agents used in their preparation (arsenic acid, &c.) and imperfectly eliminated, or lastly, to mordants employed in fixing these dyes upon vegetable tissues? The general appearance at colour- and dye-works (see Dr. Grandhomme's Report on the Hœchst Colour-Works) is certainly not in favour of the first supposition.

Under the head "Arsenical Poisoning" the useful caution is given not to administer tartar-emetic in suspected cases, as it not only depresses vitality, but its presence complicates an analysis, and it even, not unfrequently, contains arsenic. The writer places no confidence in ferric hydrate and in magnesia, unless the poison has been taken in a state of solution.

In an article on Bacteria, Dr. Charlton Bastian discusses the "germ theory" of disease. He contends that "if all the alleged cases of the coexistence of organisms with morbid processes were real . . . . still the multiplication of this evidence to any extent will never help us to solve the real question—whether such morbid processes are only caused and propagated by organisms, or whether they may at times come into existence independently?" He, very naturally, holds that the question of abiogenesis is inextricably mixed up with the question of the truth or falsity of the germ theory of disease. If organisms act as "the invariable and sole causes of disease then their presence is a matter of the deepest interest and importance. If, on the other hand, the organisms are not causes but rather concomitant products, their presence from a purely medical point of view is of trifling importance."

The Elements of Chemistry. Inorganic and Organic. By Sidney A. Norton, Ph.D., LL.D., Professor in the Ohio State University. Cincinnati and New York: Van Antwerp, Bragg, and Co.

This work presents the usual features of works of its class. There is little—exceedingly little—to which exception might be legitimately taken. There is a clear exposition of the essential facts and laws of chemical science. But, on the other hand, we fail to detect in it any broad, well-marked novelty of treatment which might give it a decided superiority over other manuals. The fact is that to write an elementary treatise on chemistry containing anything new, and at the same time true, is, for the present, scarcely within human power.

The only oversight we notice is in the account given of the "madder-style" of calico-printing, where the operation of "ageing" is made to come in after dyeing instead of after printing on the mordants or before the "dunging" process. The experiments which the author has selected in illustration have been judiciously selected, and are for the most distinguished by simplicity. To an English critic it is a refreshing feature to find no reference to any examination, and no list of questions which have been put on former occasions.

Magneto- and Dynamo-electric Machines, with a Description of Electrical Accumulators. From the German of Glaser de Cew, by F. Krohn, and specially edited, with many additions, by Paget Higgs, LL.D., D.Sc. London: Symons and Co.

This volume is the first of a set of manuals designated the "Specialists' Series," edited by Dr. Paget Higgs and Professor Charles Forbes. Of the five volumes announced, three—the present included—deal with different departments of the electical arts, whilst one is devoted to gas-engines and one to "ballooning."

In the preface to the work now before us the editor remarks:—"Now that the public has become educated (and very dearly they have paid for this education) the dynamo-machine is likely to take a fair stand in the rank of useful machines."

In successive chapters the author considers electrical units; the history of magneto- and dynamo-electric generators; machines producing alternating and direct currents; the particular applicability of the different classes of generators; automatic switches and current-regulation; electrical storage; the physical laws bearing on the construction of electric generators; the construction of the several parts of electric generators; the employment of these machines in producing the electric light, and for various other purposes.

The appendix includes formulæ for the construction of electro-magnets; a description of the instruments for measurements used in connection with dynamos and magneto-electric machines; the latest construction of generators, and the complete mathematical theory of magneto- and dynamo-electric machines as laid down by Clausius. The work is admirably and profusely illustrated and will be found very useful.

Technological Dictionary of the Physical, Mechanical, and Chemical Sciences. English, French, German, Italian, Spanish. Containing all the terms employed in Physics, Meteorology, Mechanics, Chemistry, Metallurgy, Chemical Technology, and Electro-technics. Part I. English-German. By F. J. Wershoven, D.Sc. London: Symons and Co.

Technological dictionaries of the principal languages of civilisation are becoming a special necessity, the rather as the ordinary dictionaries almost entirely ignore the technical language of the arts and manufactures.

The work before us, if fairly carried out, is likely to prove exceedingly useful. Still the manner of its execution leaves something to be desired. The textile manufactures in all their branches are, so far as we can perceive, entirely omitted. Among the chemical arts great care has been bestowed upon brewing, sugar-refining, and the glass manufacture, but bleaching, dyeing, and tissue printing, have been to a great extent left out in the cold. In a technological dictionary we naturally expect to find mention of such important articles of commerce as far-wood, brazil-wood, catechu, cochineal, cudbear, cutch, fustic, logwood, peachwood, &c.; of preparations like alizarine oil, black liquor, red liquor, dung substitutes; of appliances such as the padding-machine, the ageing-machine, the steam chest, the kier, &c., of the different styles of printing and the like. But all this, and much more, is omitted. Were it not, indeed, for the mention of indigo, lac, and madder, we might almost conclude that the tinctorial arts were not included in the author's plan.

We come, too, not rarely, upon terms which, though they may possibly have been at one time or other used by English writers, are not at all current. We doubt if any person connected with the woollen trade would understand "baptisterium" to mean a fulling-mill. "Adragant" is not English; our name for that gum being tragacanth. Apyrous, Araxes soda, Adamic earth, nitriary, are terms which would be intelligible to few persons in this country. "Daltonism" is a synonym used in France for colour-blindness, but it is not accepted by good English writers. "Farina" ordinarily signifies potato-starch, but in the work before us it is interpreted as the meal or dust of hops. We trust that in the remaining parts of this book such sins of omission and commission will not be permitted to recur. Of course if the omissions which we have pointed out were supplied, the book would necessarily be more bulky. Still no little space might be economised by the omission of words which are identical in both languages. Of such there is no lack.

CORRESPONDENCE.

ACCIDENT TO DR. DIVERS OF TOKIO.

To the Editor of the Chemical News.

Sir,—By this American mail from Japan I am informed by my brother, who is in the Consular Service at Tokio, Japan (and a friend of Dr. Edward Divers), that Dr. Divers is now gradually recovering from the severe explosion which was thought would have ruined the sight of one of his eyes. I am sure chemists will only be too glad to hear that Dr. Divers's sight will be completely restored in time.—I am, &c.,

A. B. Griffiths, Ph.D., F.C.S., &c.

Technical College, Manchester.
February 5, 1885.

BEHAVIOUR OF METALLIC SOLUTIONS WITH FILTER-PAPER.

To the Editor of the Chemical News.

Sir,—In Chemical News, vol. li., p. 51, you inserted a paper by Mr. J. U. Lloyd on "Separation by Capillary Attraction," in which certain experiments illustrating the power of filter-paper to separate salts from their solvents are described as new.

Will you kindly permit me to state that in a paper read before the Chemical Society, and published in the *Journal* (August, 1878), I described almost exactly similar experiments. These were made in Prof. Galloway's laboratory in Dublin with salts of silver, copper, cadmium, lead, mercury, nickel, cobalt, and iron, and with the hydrates of calcium, sodium, and ammonium, and the phenomena are referred to capillarity.

The following is a quotation from the paper:—

"Drops of metallic solutions were placed upon filter-paper, and submitted to the action of sulphuretted hydrogen. I found that in some cases the metal extends to the edge of the spot, and even seems concentrated there, while on others a water-ring surrounds the patch of sulphide. Further inquiry demonstrated that solutions of the same metal present the first or second of these phenomena, according as they are concentrated or dilute. Taking a strong solution of copper sulphate and diluting portions of it, I found that at one degree of dilution the metal spreads outwards just as far as the water, and that with solutions more dilute than this the water is separated from the metal, which remains in the centre. The more dilute the sotution the broader is the external water-ring. The exact strength of solution to give the former appearance varies with the temperature, and with the kind of paper used; the metal in a warm solution is more mobile than if the solution were cold."—I am, &c.,

Thomas Bayley.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

Note.—All degrees of temperature are Centigrade unless otherwise expressed.

Zeitschrift für Analytische Chemie.
Vol. xxiv., Part 1, 1885.

Assay of Lead in the Wet Way.—C. Roessler.—The substence of this very extensive memoir will be given at an early opportunity.

A Method for the Volumetric Determination of Nitric Acid.—Antonio Longi.—(See page 76.)

A Contribution to the Determination of Extract in Wines.—C. Weigelt.—The ordinary method of determining the extract in wines is to evaporate under identical circumstances equal quantities of wine, and consequently to weigh very different quantities of extract. It is plain that in wines rich in extract the dry residue which is weighed will be less perfectly dehydrated than that of a wine poor in extractive matter evaporated under the same circumstances. For a long time the volatility of glycerin was overlooked, as also the fact that the organic acids of wine undergo decompositions on prolonged drying at 100°. The author proposes so to arrange the volume of the samples taken that the quantity of residue to be weighed may be always the same. For this purpose a prior approximate determination is necessary.

Detection of Caramel.—Dr. C. Amthor.—If an alcoholic fluid coloured with caramel is mixed with paraldehyde there is formed a brown precipitate, and the liquid is decolourised. Upon this reaction the author founds a method for detecting caramel in white wines and spirits. He prepares a caramel solution of known strength by caramelising 10 grms. of pure cane sugar. To remove undecomposed sugar he adds yeast to the solution, filters after fermentation, and makes up to 100 c.c. 1 c.c. of this solution was mixed with 9 c.c. water, 50 c.c. paraldehyde and absolute alcohol. After 24 hours the liquid was colourless, and at the bottom of the vessel the caramel was found as a brown amorphous mass. Ten c.c. of a pure white wine gave a perfectly white precipitate if mixed with 30 c.c. paraldehyde and water. If 0·1 c.c. of solution of caramel was added a brownish yellow amorphous precipitate appeared in 24 hours. For detecting caramel in wines and spirits 10 c.c. of the sample are mixed in a tall, narrow glass with perpendicular sides, and then with absolute alcohol until the liquids mix. In case of wines 15 to 20 c.c. of alcohol are necessary. If caramel is present there is formed within 24 hours a precipitate of a yellowish brown varying to dark brown, according to the quantity of caramel present. The precipitate is re-dissolved in hot water, filtered, and concentrated to 1 c.c. The quantity of caramel may be approximately estimated from the intensity of the colour.

Certain Titrations with Potassium Permanganate.—W. Lenz.—This memoir will be inserted in full.

A Thermo-regulator of a very simple Construction which may be used as a Self-registering Thermometer.—E. H. von Baumhauer.—This memoir cannot be reproduced without the two accompany figures.

Analytical Operations and Apparatus.—Dr. R. Wollny.—This paper requires the eight accompanying illustrations.

A Modification of Schiff's Apparatus for the Volumetric Determination of Nitrogen.—L. Gattermann.

Apparatus for Filtering and Drying easily Oxidisable Precipitates.—W. Bachmeyer.

Zulkowsky's Azotometer.—Modified by A. Gawalowski.—These three papers also cannot be intelligibly reproduced without the appended illustrations.

Reply by R. Kissling.—The continuation of a controversy between this writer and Professor Skalweit.

Portland Cement and the Detection of Foreign Additions.—R. Fresenius and W. Fresenius.—Not adapted for useful abstraction.

An External Liquid in Dialysis.—H. Struve.—The author recommends a solution of chloroform in water, as also ether. As a membrane he invariably employs bladder or gut, since parchment paper is never sufficiently homogeneous.

Rapid Expulsion of Air in Boiling Flasks.—An improvement on Grandeau's modification of Schlösing's apparatus for the determination of nitric acid.

On Nickel Apparatus for Laboratory Use.—M. Mermet.—From the Chemical News.

Vessels resisting Alkalies.—Prof. Dittmar.—From the *Journal Soc. Chem. Industry.*

The Acceleration of the Precipitation of Silver Chloride.—M. Whittel.—The author adds a few drops of chloroform, which exerts a purely mechanical action.

Apparatus for Collecting and Measuring Gases, especially Nitrogen, in Dumas's Process for Determining Nitrogen.—M. Glinski.—An illustrated paper from the *Berichte d. Deutsch. Chem. Gesell.*

The Illumination of the Half-shade Polarising Apparatus.—E. Allary.—From the *Bulletin de la Soc. Chimique de Paris.*

Small Laboratory Apparatus.—Illustrated notes on improved pieces of apparatus.

Crucibles of Steatite.—H. Kraetzer.—The author recommends these crucibles as preferable to platinum, silver, porcelain, &c., especially in fusions with caustic alkalies. They never burst, wear away, or allow the contents to ooze through. They improve with use, but when first employed they must be heated cautiously.

The Preparation of Caoutchouc Tubes absolutely Impervious to Gases.—J. Fletcher.—From the Chemical News.

Purification of Filter-Paper with Hydrochloric Acid.—V. Kreusler.—The author lays several half-sheets of paper one upon another, and places them in a vessel containing dilute hydrochloric acid, so that they may hang down over the side. The acid traverses the paper by capillarity and syphon-action, and drops from the outer end of the sheets. Meantime distilled water is allowed to drop into the vessel from a Mariotte's bottle, until the liquid draining from the paper is free from acid reaction.

Preparation of Large Quantities of Oxygen.—B. Tacke.—An illustrated paper from the *Berichte d. Deutsch. Chem. Gesell.*

The Preparation of Zinc Free from Arsenic.—L. L'Hôte.—From the *Comptes Rendus.*

Purification of Zinc from Arsenic.—F. Stolba.—From the Chemical News.

Impurities in Commercial Hydrochloric Acid.—A. Goldammer.—Calcium chloride and tin have been respectively detected in different samples of hydrochloric acid. The former impurity seems to be found in samples of acid made from calcium chloride in ammonia-soda works. Tin is derived from the stannous chloride used for the removal of arsenic.

The Use of Lime-Water in Zinc Gas-holders.—U. Kreusler.—The author has observed that this liquid, used according to Löwe's proposal in gas-holders containing oxygen, quickly attacks the metal.

Sensitiveness of Permanganate to Light.—A. Reissmann.—The author observes that crystals of this salt undergo a superficial decomposition on exposure to light. Hence he recommends that standard solutions of permanganate should be kept in the dark.

Separation of Strontia from Lime.—D. Sidersky.—This paper will be inserted in full.

Volumetric Determination of Chromium Sesquioxide.—B. Pawolleck.—The author introduces the substance in question containing 0·3 to 0·5 grm. Cr_2O_3 into an Erlenmeyer's flask, dissolves in about 25 c.c. nitric acid of sp. gr. 1·40, and boils gently, adding by degrees crystals of potassium chlorate until the liquid takes the pure orange colour of a solution of chromic acid. All the decomposition products of the chlorate are expelled by boiling, the solution is let cool, diluted with 300 to 400 c.c. water, and titrated in the ordinary manner with a solution of ammonium-ferrous sulphate. It is advisable to ascertain at first, by super-saturation with ammonia, whether any chrome oxide has escaped oxidation.

Determination of Molybdenum.—Baron Otto von der Pfordten.—Already noticed under *Berichte Deutsch. Chem. Gesell.*

Determination of Tungsten.—Baron Otto von der Pfordten.—Already noticed from *Berichte Deutsch. Chem. Gesell.*

Separation of Iodine and Chlorine in the Dry Way.—Jean Krutwig.—If a dry mixture of potassium iodide and potassium dichromate (the latter in excess) is heated, the iodine escapes, whilst alkaline chlorides present are not attacked. The iodine is determined as loss or calculated from the weight of the chromic oxide formed. In the filtrate, acidified with nitric acid, chlorine is determined as silver chloride in the usual manner.

A New Test for Nitrous Acid.—R. Meldola.—Para-amido-benzol-azo-dimethyl-aniline is readily diazotised by the action of nitrous acid, and the tetrazo salt thus formed has the property of taking a strong blue colour when its dilute solution is exposed to the air. The author utilises this property for the detection of nitrous acid. In order to obtain the above-mentioned compound para-nitraniline is diazotised in the customary manner, and the solution is mixed with the theoretical quantity of dimethyl-aniline, dissolved in dilute hydrochloric acid. The mixture soon turns red, and after being allowed to stand three to four hours at freezing-point there is formed a fine crystallised deposit of the hydrochlorate of the nitro-azo compound. This precipitate is filtered off, carefully rinsed with water, and reduced as follows:—The substance is placed in a flask, and heated to a boil with alcohol and hydrochloric acid until completely dissolved. We thus obtain a fine red liquid, which is turned to brown on the addition of ammonia, whilst a small quantity of a base is precipitated. If ammonium sulphide is added to the hot solution, and the whole boiled for ten to fifteen minutes, the precipitate is re-dissolved, and the previously brown colour turns to a yellowish orange. As soon as the reduction is completed the alcoholic solution is poured into an excess of cold water, and let stand for some hours. The amido base separates out as a dark orange powder. It is collected, carefully washed in water, dissolved in cold dilute hydrochloric acid, filtered, and the base is again precipitated with ammonia. If it still does not dissolve without residue in dilute hydrochloric acid the purification is repeated. The solution is prepared for use by dissolving 0·5 grm. of the amido-base in dilute hydrochloric acid, so as to make 1 litre. The solution has a deep red colour. In order to test a liquid for nitrous acid a few drops of the red solution are added, and immediately afterwards a few drops of hydrochloric acid. Ammonia is then added by drops, stirring after each drop until the blue colour appears.

Detection of the Pyridine Bases.—A. W. Hofmann.—A few drops of the base under examination are heated in a test-tube with an equal quantity of methyl iodide, and the substituted ammonium iodide formed is mixed to a thick paste with a little powdered potassium hydrate and water, and gently heated. A vapour of pungent, characteristic odour is evolved.

A Reaction of Tannin, Gallic, and Pyrogallic Acids.—O. Nasse.—The bodies in question, whether in an aqueous or alcoholic solution, and in presence of neutral or acid salts, which in themselves occasion no precipitate or colouration, take a transient purple-red colour on the addition of solution of iodine.

Action of Dilute Hydrochloric Acid upon Starch.—F. Allihn.—The author studies the most favourable proportions for the saccharification of starch.

Detection of Nitrogen in Organic Bodies.—C. Graebe.—Lassaigne's process, which depends on the formation of cyanogen on heating with potassium, does not reveal the nitrogen in diazo-compounds. If sulphur is present a larger quantity of potassium is used.

The Nitrogen Process of Dumas in case of Volatile Sulphuretted Compounds.—V. Meyer and O. Stadler.—Such bodies must be ignited very slowly, and with a long layer of lead chromate placed at the anterior end of the tube, as otherwise carbon monoxide may be formed and measured as nitrogen.

Method for Determining the Halogens in the Lateral Chains of Aromatic Compounds.—K. F. Schulze.—The author places the weighed substance in a small flask fitted with a reflex condenser along with an alcoholic solution of silver nitrate, and boils for five minutes. The eliminated silver haloid is collected in a Gooch platinum crucible, with a perforated bottom covered with asbestos, washed with alcohol, then with water containing a little nitric acid, and again with alcohol. The residue is dried over an open flame, and gently ignited.

Determination of the Three Xylols in Crude Xylol-Oil.—I. Levinstein.—Already noticed.

Determination of the Proportion of Glycerin in Aqueous Solutions.—W. Lenz.—The results are given in tables which do not admit of abridgment.

Determination of Aqueous Solutions of Beet-Sugar.—F. Strohmer.—Similar tables for beet-sugar.

Circular Polarisation of Beet-Sugar.—B. Tollens.—The author undertakes an examination of the various instruments in use.

Determination of Starch in Grain.—C. O'Sullivan.—From the *Journal of the Chemical Society.*

MEETINGS FOR THE WEEK

MONDAY, 16th.—London Institution, 5.
—— Medical, 8.30.
TUESDAY, 17th.—Royal Institution, 3. "Museums and National Education," by Prof. S. Colvin.
—— Institution of Civil Engineers, 8.
—— Pathological, 8.30.
WEDNESDAY, 18th.—Society of Arts, 8. "Malt Making," by H. Stopes.
—— Meteorological, 7.
THURSDAY, 19th.—London Institution, 5 and 7.
—— Royal, 4.30.
—— Royal Institution, 3. "The New Chemistry," by Prof. Dewar.
—— Royal Society Club, 6.30.
—— Chemical, 8. "On Ethylic Benzoylacetate and some of its Derivatives (Part II.)," by Dr. W. H. Perkin, junr. "On Toughened Filter-Papers," by E. E. H. Francis. "The Detection and Estimation of Iodine," by Ernest H. Cook, B.Sc. "Note on Methylene Chloriodide," by Prof. J. Sakurai. "A Quick Method for the Estimation of Phosphoric Acid in Fertilisers," by J. S. Wells.
FRIDAY, 20th.—Royal Institution, 8. "Solar Corona," by Dr. W. Huggins, at 9.
SATURDAY, 21st.—Royal Institution, 3. "The Scale on which Nature Works," by G. Johnstone Stoney.

THE CHEMICAL NEWS.

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NOTE ON THE CONDENSATION OF GASES AT THE SURFACE OF GLASS.[*]

(Preliminary.)

By J. T. BOTTOMLEY, M.A., F.R.S.E.

It is well known to those who have endeavoured to obtain, in glass vessels, the very perfect vacuums first sought after and obtained by Crookes, and producible by the mercurial pumps, that the operation is much assisted by heating the glass vessels to be exhausted, and even the tubes of the pump, to a high temperature. The difficulty of removing the film of air and moisture adhering to glass tubes is also well known to makers of barometers and thermometers.

When the Sprengel pump is used for producing a vacuum, and when a tolerably good vacuum has been produced, so that the barometric gauge indicates a pressure of one millimetre or half a millimetre of mercury, the drops of mercury falling in the tube of the Sprengel give rise to a loud metallic hammering sound; and they fall with such unbroken sharpness that those who use this form of pump are often troubled by the "fall-tubes" splitting longitudinally through a length of several inches —a phenomenon in itself very remarkable, considering the strength of the tubes and the smallness of the mercurial drops. If while this hammering is going on the glass vessel which is being exhausted and the leading tubes of the Sprengel pump be heated by passing the flame of a spirit-lamp or of a Bunsen burner over them, the hammering immediately ceases, and on looking closely at the fall-tubes it is seen that they are carrying down air which in the heat was liberated from the glass walls of the apparatus. The ordinary barometer gauge is scarcely sensitive enough to show an increase of pressure, but the McLeod gauge readily shows it.

There is another well-known phenomenon connected with the condensation of gases and vapours on the surface of glass, viz., the condensation of a watery film over the glass of electric apparatus, in virtue of which, at temperatures considerably above the dew-point, the glass supports are not insulators of electricity. This film of moisture is removed by exposing the glass stems to heat, or to an artificially-dried atmosphere. Some years ago, at the wish of Sir William Thomson, I endeavoured to weigh this film of moisture, but was absolutely unsuccessful. The film must be of extreme tenuity. Prof. Quincke has, however, made important researches on the "distance of capillary action," and on some of the properties of these very thin films. His results are given in two papers, *Poggendorff's Annalen*, 108, p. 326, 1859; and *Wiedemann's Annalen*, vol. ii., 1877, p. 145. He finds their thickness to be comparable with 5×10^{-5} c.m.

With the view of measuring the quantity of gas condensed upon a given surface of glass, I caused to be prepared in August last a large quantity of fine glass thread. Some of this was of flint glass rod or cane, which was softened in the blowpipe flame, and drawn out into a wheel. The remainder was of flint glass tubes, drawn out in a similar way. The spun glass was carefully parcelled up in paper, and put aside till I should be ready to use it,

On January 3rd I put a quantity of the non-tubular glass fibre into a glass tube 2 c.m. in diameter and 12 c.m. long, and attached it by a glass sealing to a five-fall Gimingham Sprengel pump. The pump, which was in excellent order, was then worked rapidly till I had produced a very good vacuum, which by the McLeod gauge gave me an indication of 0·3 M pressure.[*] The pump was then left for about an hour, and at the end of that time, passing one more bottle-full of mercury through the pump, I ascertained that the vacuum had not sensibly deteriorated, the McLeod gauge giving identically the same reading as before. This exhaustion was performed without the application of any unusual heat to the tube containing the glass fibres. The temperature of the room was about 56° F.

I now raised the mercury to the upper level, and allowed it to flow through the pump, and the drops fell with the well-known loud hammering noise. While this was going on I applied a Bunsen burner to the tube containing the spun glass. In a few seconds the hammering of the mercury ceased, and on applying the test of the McLeod gauge the pressure within the pump was found to have risen largely. I did not, however, obtain a measurement with the gauge corresponding to maximum pressure of the gas driven off, or to any particular state. I believe that even the barometric gauge showed depression, but I had no assistant at the moment, and was unable to secure a reading.

I now proceeded to pump out all the gas I could, working the pump, and heating the tube containing the glass fibres strongly. The heating was carried on from time to time till the tube, which was of German glass showed signs of softening and of falling in; and the glass fibres were likewise, some of them, slightly softened and bent.

The pump was worked for over an hour, the heating being applied, and the gas, which was easily seen being carried down, was collected in a tube made for the purpose, which fitted on over the upturned ends of the five fall-tubes. At the end of this time the vacuum was again fairly good, though not so good as it was before the heating commenced. The McLeod gauge indicated 1·2 M. It was seen that very little more air was being carried down, and I did not wish to push the vacuum farther than, or quite so far as, the vacuum which had been obtained before the liberation by heat of the condensed gas,

The collecting tube was now removed, and the gas obtained was measured and analysed, so far as it was possible to analyse a quantity so small.

The total amount of gas collected was calculated to be, at 15° C. and a pressure of 760 millims., 0·45 of a cubic centimetre. To this a small quantity of strong solution of caustic potash was added, and time was given for absorption. A small quantity of pyrogallic acid was next added, and the further absorption observed. The residue was so small that I could do nothing farther.

The result of the analysis showed 8·24 per cent of the whole to be carbonic acid gas (absorbable by caustic potash). Of what remained 24·8 per cent was oxygen (absorbable by pyrogallic acid and caustic potash mixed). The residue 75·2 per cent was, I presume, mainly if not wholly nitrogen. I ought to remark that my pump was furnished, as is usual, with the phosphoric acid drying tube. The gas, therefore, which I collected was perfectly dry, and I have no way at present of ascertaining how much moisture adheres to the spun glass, though I am hoping to make experiments for this purpose shortly. In stating the results of the analysis I have made no correction for moisture introduced with the potash solution.

In order to make an estimate of the amount of surface exposed by the spun glass, I measured with a screw micrometer gauge the diameter of 200 of the fine glass fibres taken at random. I found them, as I expected from the care with which they had been prepared, fairly uniform, and the average diameter was 7·06 hundredths of a millimetre. Weighing also the 200, and then the whole quantity, I found the whole number of the fibres to be 6370. The average length was 10·25 c.m. The surface was thus 1448 sq. cm., or equal to that of a square 38 c.m. in the edge.

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[*] A Paper read before the Royal Society, February 12, 1885.

[*] M standing for one-millionth of one atmo,

I am preparing for further experiments on this subject, and hope soon to be able to add to it observations on the amount and on the electric conductivity of the film of moisture condensed upon the surface of glass.

ON HERDERITE.*

By F. A. GENTH.

In the *American Journal of Science* [3], xxvii., 135 to 138, in an article on Herderite, by William Earl Hidden and James B. Mackintosh, the latter published his analysis of this rare mineral from Stoneham, Me. In a letter to the editors of the *Neue Jahrbuch der Mineralogie, &c.*, of 1884, ii., 134 to 136, Professor A. Weisbach gives the results of a comparative examination of the *original* herderite from Ehrenfriedersdorf, Saxony, and of that of Stoneham, Me., made at his suggestion by Dr. Cl. Winkler.

These investigations, showing remarkable discrepancies not only between Dr. Winkler's analyses of the herderite from the two localities, but also between those of the two analysts of the Stoneham mineral, it was desirable to re-examine this interesting species.

I am under great obligations to Mr. George F. Kunz, who has kindly furnished me with the material for this investigation, from which I was able to pick out over 2·5 grms. of pure crystals.

Referring to the occurrence of herderite, he has sent me the following communication, dated New York, October 14, 1884:—

"On revisiting the Stoneham locality I found that the herderite had all been obtained from a vein of margarodite, four feet wide, about twenty feet long, worked to a depth of ten feet. This vein is on the side of the top of Harndon Hill, about one hundred feet from the place where was found the topaz obtained by me (see *Proceedings New York Academy of Science*, November and December, 1882, and *American Journal of Science*, Feb., 1883), and not in the same pocket, as stated in the article in the *American Journal of Science*, Jan. 7, 1884. The vein is almost entirely margarodite, occurring here in unexampled crystals. These at times cover spaces four or five inches square, with distinct perfect crystals of margarodite, also altering to serpentine, and associated with it what is possibly topaz, altered into serpentine.

"The herderite occurs almost invariably in crystals, implanted on the margarodite, crystals of quartz, and in a few instances on columbite.

"Between the herderite vein and the topaz vein worked by me were found the large columbite and triplite. Two distinct crystals of triplite have been found recently.

"(Signed), George F. Kunz."

The analysis of herderite presents great difficulties, and the following methods have been used in the different analyses:—

I. A portion of the material was slightly yellowish, and probably contaminated with a trace of mica. 1·0334 grms. were slowly ignited to a bright red-heat in a well-covered platinum crucible, and lost 4·80 per cent. After ignition the lid and outside margin of the crucible were found coated with a film, which, when moistened with water, gave a strongly acid reaction.

About equal weights of silica and the mineral were fused with about six parts of sodium carbonate for one hour. The well-fused mass, which was greenish from a minute quantity of manganese, was lixiviated with water, and should now have contained *all* the phosphoric acid and fluorine. The silica in the solution was precipitated by ammonium carbonate, and from its filtrate the remaining silica by zinc oxide, dissolved in ammonium carbonate and ammonia. From the filtrate of the zinc silicate after evaporation to dryness and dissolving in water, the greater portion of the sodium carbonate was neutralised with dilute nitric acid, then precipitated with silver nitrate, keeping the liquid slightly alkaline. In the filtrate the balance of the fluorine (which had not been expelled by ignition) was precipitated, together with calcium carbonate, by calcium chloride. The mixed precipitate was ignited, dissolved in acetic acid, evaporated to dryness, the calcium acetate dissolved out by water, and the calcium fluoride determined. It gave 1·57 per cent, which would give, with that driven off by ignition, about 6·4 per cent.

The zinc silicate precipitate was found to contain phosphoric acid.

The portion insoluble in water was dissolved in a little hydrochloric acid, and the clear solution precipitated by ammonia, and this separation twice repeated, and washed, until the filtrate was free from lime. The precipitate was ignited and weighed. It gave over 37 per cent, and contained a large quantity of phosphoric acid. It was then re-dissolved in hydrochloric acid, the excess driven off by evaporation, then dissolved in water, and enough sodium hydrate added to re-dissolve the greater portion of the precipitate. From the filtrate of the insoluble portion the phosphoric acid was precipitated by barium hydrate as barium phosphate. In the filtrate from this the excess of barium was removed by sulphuric acid, and from the filtrate of the barium sulphate the glucina and alumina were precipitated with ammonia. The residue insoluble in sodium hydrate contained about 4·5 per cent of lime, nearly 3 per cent of phosphoric acid, a little iron and glucina and alumina, which latter were added to the ammonia precipitate.

These were then re-dissolved in as little acid as possible, precipitated by ammonia, and the separation of glucina from alumina attempted by that method recommended by the highest authorities as the most perfect, namely, boiling these hydrates with a concentrated solution of ammonium chloride. The strength of the solution was kept so that on cooling a small quantity of ammonium chloride crystallised out. It was boiled briskly for a whole day, and did not show any bumping at all; a large insoluble residue remained. It had a slightly yellowish colour from a little iron, but had not the slimy gelatinous appearance which alumina would have presented, but, on the contrary, it was, without being crystalline, more granular, and resembled beryllium hydrate precipitated on boiling from a dilute solution in sodium hydrate. The filtrate was precipitated with ammonia, and gave 5·61 per cent of ignited beryllium oxide. That portion insoluble in ammonium chloride dissolved readily in a minute quantity of dilute hydrochloric acid. Sodium hydrate was now added, and the whole evaporated in a platinum dish to a pasty consistency, then diluted with cold water, and the little ferric hydrate filtered off, which was subsequently dissolved in hydrochloric acid, precipitated by ammonia. In washing the iron precipitate the filtrate became gradually more and more turbid. It was still more diluted with water and boiled for about one hour, when it was filtered off and washed; it gave 8·99 per cent.* The filtrate was now acidulated with hydrochloric acid and precipitated by ammonia, and gave 0·17 per cent of alumina, which was dis-

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* Read before the American Philosophical Society, October 17, 1884.

* This unexpected behaviour of glucina with a boiling solution of ammonium chloride induced me to make the following experiments:—A quantity of beryllium carbonate, prepared from beryl, from Ackworth, N.H., was dissolved in hydrochloric acid; to the strongly acid solution ammonia was added until it showed a slightly alkaline reaction. It was boiled briskly for one day, then filtered; the undissolved residue was again dissolved in an excess of hydrochloric acid, precipitated by ammonia, and boiled for another day and filtered. The two filtrates were mixed and precipitated by ammonia, and gave 0·1158 grm. of beryllium oxide. The insoluble residue was dissolved in just enough hydrochloric acid, precipitated and re-dissolved by sodium hydrate, diluted with much water, and boiled for one hour. The precipitate weighed after ignition 0·1422 grm. Both were converted into anhydrous sulphates, the first furnishing 0·4742 grm., containing SO_3=75·58 and BeO=24·42; the second gave 0·5912 grm. sulphate of beryllium with SO_3=75·95 and BeO=24·05.

	Stoneham.						Ehrenfriedersdorf.
	I.	II.	III.	IV.	Mackintosh.	Winkler.	Winkler.
P_2O_5 =	41·76	43·01	43·38	43·43	44·31	41·51	42·44
BeO =	14·60	15·01	15·17	15·04	15·76	14·84	8·61
Al_2O_3 =	0·17	0·22	0·09	0·20	—	2·26	6·58
Fe_2O_3 =	0·48	0·31	0·49	0·15	—	1·18	1·77
MnO =	0·09	0·08	0·12	0·11	—	—	—
CaO =	33·96	34·06	33·74	33·65	33·21	33·67	34·06
H_2O =	—	—	? 0 61	? 0·61	—	6·59	6·54
Fl =	—	? 6·04	—	8·93	11·32		
				102·12	104·06		
Less O =				3·76	4·76		
				98·36	99·84		

solved in hydrochloric acid and precipitated by ammonia, and was found to be insoluble in ammonium carbonate.

The different constituents were added together, and gave the results given below. A considerable quantity of phosphoric acid was lost probably in the zinc silicate before I was aware of the fact that this retained such a large portion of it, and only 41·76 per cent were obtained.

II. 0·8608 grm. of finely-powdered perfect crystals, dried over one week over sulphuric acid, was fused with twice its weight of silica and sodium carbonate, and the mass treated as in I. It was found, however, that for this mineral this method, even with such an excess of silica, cannot be used advantageously, as the phosphoric acid, notwithstanding the most careful operations, was contaminating almost every precipitate, and was largely contained in the zinc silicate. After the greater portion of the phosphoric acid was obtained there was still about 4·5 per cent with the glucina and ferric oxide, from which it was separated by ammonium molybdate. The excess of molybdic acid was removed by precipitating the slightly acid solution by nitrate of lead. The excess of lead and trace of molybdenum were precipitated by hydrogen sulphide, and from the filtrate the glucina, ferric oxide, and alumina separated by sodium hydrate as in I. I am afraid that a portion of the fluorine was lost in a similar way. The ignited calcium fluoride was treated with sulphuric acid, and weighed as calcium sulphate, and, as probably a little silica was there which was volatilised as silicon tetrafluoride, it lost 1 per cent, and gave only 6·04 per cent of fluorine.

III. 0·3303 grm. of the same material as I. was intimately mixed with a known quantity of freshly ignited plumbic oxide, and put in a small platinum crucible with close cover. This was placed in a larger platinum crucible which had some magnesia in the bottom. It was then tightly covered, and gradually heated to a strong red-heat, which was continued for twenty minutes. After cooling the small crucible had sustained a loss of 0·0020 grm., which would represent 0·61 per cent. The contents of the crucible were completely fused, and the lid showed a slight film. As lead fluoride is slightly volatile, it is a question whether this very small loss may not be owing to this, and that the mineral is anhydrous.

The fused mass was dissolved in acetic acid and filtered, the residue, consisting mostly of lead phosphate and fluoride, was dissolved in diluted nitric acid. A pulverulent residue, containing amongst other substances calcium fluoride, was filtered off, the fluorine driven off by sulphuric acid, and the sulphates added to the other portion of the analysis. It was found that a considerable portion of the lead phosphate had gone in solution, therefore all the liquids, from which the lead had been removed by hydrogen sulphide, were united, and the analysis finished as under II.

IV. 0·5860 grm. of the very finely powdered perfect crystals from another specimen with traces of albite was placed in a platinum crucible moistened with water, and then sulphuric acid was added, and it was evaporated until copious fumes of sulphuric acid went off. It was dissolved in water and hydrochloric acid. A very slight portion, 0·0070 grm., escaped the decomposition, and was therefore deducted from the original quantity. The solution was precipitated by ammonia, which would precipitate all the glucina, alumina, ferric oxide, and a part of the lime in combination, with all the phosphoric acid, and would leave the calcium which was in combination with the fluorine in solution. I found that 13·16 per cent had not been precipitated, which corresponds to 8·93 per cent of fluorine, which is probably more correct than 6·04 per cent as found by direct determination. The precipitate by ammonia was dissolved in nitric acid, the phosphoric acid precipitated by ammonium molybdate, and the analysis finished as above.

To my four analyses I add for comparison those of Mr. Mackintosh and Dr. Winkler.

Silicic acid and the alkalies belonging to the albite, &c., have not been determined. It should be remembered, however, that 0·20 alumina represents 1 per cent of albite.

The analysis made by Mr. Mackintosh and myself show that herderite is anhydrous beryllium calcium phosphate and fluoride, with traces only of alumina and ferric oxide, and perhaps a little water. The traces of alumina are owing to slight admixtures of traces of mica and albite.

Somewhat doubtful is the exact quantity of fluorine which it contains. Mr. Mackintosh determined its quantity from the excess of lime which he found. A determination which I have made in the same manner gave me a far lower result,—instead of 11·32, only 8·93 per cent. My direct fluorine determination is probably too low, owing to the incomplete decomposition of the mineral by fusion with silica and sodium carbonate and the difficulties in the separation of fluorine from such a solution. A doubt also exists as to the 0·61 per cent loss by fusion with plumbic oxide, whether it is water or lead fluoride.

As all my material was used up I could not attempt any other determination for clearing up these doubtful points.

It is to regretted that the results of Dr. Winkler's two analyses are so very unsatisfactory, and that he has sacrificed the very precious Ehrenfriedersdorf herderite by employing incorrect methods for his analysis.

By ignition he has volatilised the greater portion of the fluorine, then by evaporation with nitric acid the rest may have gone (although nitric acid is less liable to drive off hydrofluoric acid than hydrochloric acid would be); therefore, when he subsequently tested for fluorine, there was no more left than sufficient to give a *doubtful reaction.*

Although it is stated ("Rose's Qual. Analyse," Leipzig, 1867, p. 212), incorrectly as I believe, that boiling with sodium acetate does not precipitate glucina, I am not aware that this method has ever been suggested to separate glucina from alumina by boiling a solution, nearly neutralised with sodium carbonate, with sodium acetate. It is a known fact (see Graham-Otto's "Anorganische Chemie," by Michaelis, iii., 2 Hälfte, p. 694) that from a solution of beryllium chloride the glucina is precipitated on boiling with sodium acetate.*

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* In order to show the value of the method used by Dr. Winkler for the separation of alumina and glucina, a quantity of beryllium carbonate was dissolved in hydrochloric acid, evaporated to dryness,

Dr. Winkler does not state that he has tested his so-called *alumina* for its purity, which is unfortunate, or he would have found that a slight trace of it might have been present, but that the precipitate was nearly pure glucina. *There can be very little doubt that the Ehrenfriedersdorf and Stoneham mineral are identical in composition.* There is also a larger percentage of ferric oxide in Dr. Winkler's analysis than found by me. Might not this have come from the molybdic acid which he used? The ammonium molybdate—prepared from Merk's molybdic acid—which I use contains in in 100 c.c. 0·002 grm. ferric oxide. As I used measured quantities a corresponding amount of ferric oxide was deducted.

ON A NEW BLOWPIPE REAGENT.

By Messrs. WHEELER and LUDEKING..

In vol. i. of the *Transactions of the Royal Society of Canada* there is published a very valuable article, by Dr. E. Haanel, on the use of hydriodic acid as a blowpipe reagent. In using this reagent he obtains a series of very striking and characteristic coatings of the iodides of many of the volatile elements. Dr. Haanel has not only described these reactions, but in addition has given a very complete series of plates illustrating the colours of these different coatings. In verifying these new reactions, it occurred to the writers that they might be equally well obtained by the cheaper and more convenient reagent, tincture of iodine. The objections to the use of hydriodic acid are the difficulty of preparing it and its liability to decomposition; and in carrying out a series of experiments it was found that the tincture of iodine was as satisfactory as the hydriodic acid. As these reactions are new and the original article is difficult of access, we have thought it might be of interest to describe them, in addition to calling attention to the much more convenient substitute of the tincture for the acid. The tincture of iodine is prepared by making a saturated alcoholic solution of the element, which dissolves very readily to a dark red liquid in this menstruum. The usual blowpipe charcoal support is replaced by long thin tablets of plaster-of-Paris, in order to develop the true colours of these vari-coloured iodides on a white background. These tablets are prepared by mixing plaster-of-Paris with water to a thin fluid paste, which is poured over a smooth flat surface (as a plate of glass) that has been previously oiled to prevent its adhesion. In a few minutes it will set into a hard cake; but before this takes place, when it has become stiff, it is divided by a knife or spatula into pieces about 4 by 1½ inches for use. These tablets are the supports on which these iodide reactions are made by putting the substance on one end, then moistening with the tincture, and blowing with the blue flame, when the volatilised iodides are deposited on its cold surface when suitably inclined. The oxidising flame must be employed in order to prevent the deposition of soot, which tends to interfere by its black film.

Description of the Iodide Coats.

Arsenic.—A reddish orange coating.
Lead.—A chrome-yellow coating.
Tin.—A brownish orange coating.
Silver.—A faint greyish yellow while cold, bright yellow when hot; close to assay.
Antimony.—An orange-red coating.
Mercury.—A yellow and scarlet, the yellow changing completely to scarlet on standing.
Selenium.—A reddish brown coating.
Tellurium.—A purplish brown coating.
Bismuth.—A chocolate-brown, fringed with red near the assay.
Cobalt.—A greenish brown, edged with green; brown coat evanescent, changing into faint green, especially when breathed upon.
Molybdenum.—A deep ultramarine-blue coating; close to assay, that is, a permanent oxide.
Tungsten.—A faint greenish blue near assay; that is, a permanent oxide (brought out stronger by dropping more tincture on tablet after the operation).
Copper.—A white coating.
Cadmium.—A white coating; becomes bright golden-yellow on blowing ammoniac sulphide vapours over it.
Zinc.—A white coating that soon disappears.

As the copper, cadmium, and zinc iodides are white, the tablet should first be coated with a film of soot (obtained by holding the tablet in a smoky flame), or else charcoal be used, in order to give a black background to the white coats. If to the peculiar velvety appearing chocolate-brown coating of bismuth a drop of dilute ammonia be added, or ammonia vapour be blown over it, the brown disappears, leaving a brilliant red coating. Many of these coatings are more or less evanescent, disappearing on prolonged exposure at ordinary temperatures.

In studying these coats it will be observed that we can now detect tin in the presence of zinc, which has hitherto been impossible with the blowpipe, and that we have a very striking and characteristic reaction for molybdenum. The other coatings are more or less characteristic, individually, and will find favour as confirmatory tests. For mixtures and complicated cases the iodide reactions will not supersede the standard methods. The bromide and chloride coats were also examined by the writers, but were found to be of little value on account of their uniform white colour, though differing somewhat in their volatility. Exception should be noted in the case of molybdenum, which gave the striking ultramarine-coloured oxide as noted above.—*The Engineering and Mining Journal.*

Laboratory, Washington University,
St. Louis.

COMPOSITION OF MAPLE SUGARS AND SYRUPS.

By H. W. WILEY,

Chief Chemist, Department of Agriculture, Washington, D.C.

Lately Dr. H. C. Bolton, of Trinity College, Hartford, Conn., wrote to me for information on the composition of maple sugars and syrups. I was surprised to find almost no data of this kind in chemical literature. I was led by this paucity of recorded analyses to secure samples of sugars and syrups, which I have had analysed by the Bureau of Chemistry of the U.S. Department of Agriculture.

In a paper read at the Saratoga Meeting of the American Association for the Advancement of Science, and published in volume xxviii. of the Proceedings, I showed that in pure maple sap there is no trace of any reducing sugar. All the sugar present is pure sucrose. Twenty-eight analyses of the fresh sap gave a maximum content of sucrose of 4·30 per cent, and a minimum of 1·87. The average per cent sucrose for the 28 analyses was 2·82 per cent.

Inasmuch as the maple sap is always evaporated in open pans, it is not strange that the sugars and syrups contain

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diluted with about 150 c.c. of water, nearly neutralised with sodium carbonate; then about 2 grms. of sodium acetate were added, and the solution heated. At about 80° it became turbid, and after two hours' boiling a considerable precipitate had formed, which was filtered off and washed. It was dissolved in dilute hydrochloric acid, then sodium hydrate was added to re-dissolve the precipitate, then it was diluted with much water, and gave on boiling beryllium hydrate, which after ignition weighed 0·0855 grm. The filtrate from the precipitate produced by sodium acetate was precipitated by ammonia, and gave 0·2705 grm. This shows that 24·3 per cent was precipitated by boiling, and that the method is worthless for the separation of glucina from alumina. By a greater dilution and a more strict neutralisation, perhaps, all the glucina might have been precipitated.

MAPLE SYRUPS.

No.	Sucrose by double polarisation.	Invertose.	Water.	Ash.	Undetermined.	Total.	Description and Remarks.
1	50·49	9·90	32·39	0·33	6·89	100·00	Thurber's mountain syrup, quart bottles, bought in Washington, D.C.
2	22·94	27·77	25·06	0·58	23·65	100·00	Vermont maple syrup (McClary), quart bottles, bought in Washington, D.C.
3	63·57	trace	31·52	0·69	4·22	100·00	Vermont syrup, kept in bulk, bought in Washington, D.C.
4	57·94	5·52	29·14	0·44	6·96	100·00	Do.
5	61·25	trace	29·68	0·74	8·33	100·00	Do.
6	32·07	32·79	19·01	1·00	15·13	100·00	Western Reserve (Block Bros.), half-gallon cans, bought in Washington, D.C.
7	57·71	3·24	31·34	1·14	6·57	100·00	Western Reserve (Block Bros.), kept in bulk, bought in Washington, D.C.
8	61·41	1·58	28·72	0·82	7·47	100·00	Hazen's Vermont syrup, quart bottles, bought in Washington, D.C.
9	63·78	2·00	26·69	0·84	6·69	100·00	Ohio syrup, from Mr. LaDow, Washington, D.C.
10	49·46	17·24	33·98	0·38	—	101·06	Ohio syrup, kept in half gallon cans, bought in Washington, D.C.
11	29·41	17·57	33·66	0·86	18·50	100·00	Do.
12	64·26	0·66	31·28	0·74	3·06	100·00	Hazen's Vermont syrup, in quart bottles, bought in Washington, D.C.
13	44·54	16·00	40·26	0·79	—	101·59	Syrup made from butternut tree, from Franklin B. Hough, New York.
14	62·23	0·21	35·21	0·55	1·80	100·00	Maple syrup, from Franklin B. Hough, New York.
15	42·09	17·54	33·74	0·95	5·68	100·00	Maple syrup made in 1883, from M. J. Smith, Middlefield, Mass.
16	54·80	3·24	38·58	1·03	2·35	100·00	Maple syrup made from last run of sap in 1884, from M. J. Smith, Middlefield, Mass.
17	63 87	1·39	32·11	0·71	1·92	100·00	Maple syrup made in middle of season 1884, from M. J. Smith, Middlefield, Mass.
18	64·45	1·39	31·67	0·76	1·73	100·00	Do.
19	62·90	1·78	32·84	0·68	1·80	100·00	Maple syrup made early in season of 1884, from M. J. Smith, Middlefield, Mass.
20	39·22	1·79	36·72	0·94	21·33	100·00	Maple syrup made in 1883, from M. J. Smith, Middlefield, Mass.

MAPLE SUGARS.

No.	Sucrose by double polarisation.	Invertose.	Water.	Ash.	Undetermined.	Total.	Description and Remarks.
1	84·24	6·33	8 03	0·31	1·09	100·00	In bulk, bought at Washington, D.C.
2	81 67	9·26	8·84	0 97	—	100·74	Do.
3	79·08	6·02	11·57	0·91	2·42	100·00	Do.
4	71·80	12·19	9·73	0·70	5·58	100·00	In small cakes, bought at Washington, D.C.
5	86·27	5·91	6·77	0·76	0·29	100·00	Do.
6	86·52	trace	8·63	1·06	3·79	100·00	In bulk, bought at Washington, D.C.
7	80·22	6·89	8·68	1·30	2·91	100·00	Do.
8	86·24	4·54	7·82	0·41	0·99	100·00	Do.
9	84·58	1·11	9·74	0·96	3·61	100·00	Do.
10	84·51	3·22	8·24	1·26	2·77	100·00	Do.
11	85·42	0·87	8 78	0·67	4·26	100·00	Do.
12	84·14	6·57	7·47	0·49	1·33	100·00	Do.
13	85·68	0·43	10·81	1·21	1·87	100·00	Do.
14	85·13	2·23	6·83	1·50	4·31	100·00	Do.
15	84·72	0·80	9·53	1·21	4·54	100·00	Sugar made early in season of 1884, about March 20, from M. J. Smith, Middlefield, Mass.
16	82·36	2·10	10·75	1·25	3·54	100·00	Sugar made early in season of 1884, from M. J. Smith, Middlefield, Mass.
17	86·97	1·69	7·68	1·06	2·60	100·00	Sugar made early in season of 1884, from M. J. Smith, Middlefield, Mass.
18	86·28	2·10	7·59	1·27	2·76	100·00	Sugar made early in season of 1884, from M. J. Smith, Middlefield, Mass.
19	86·89	2·08	7·96	1·06	2·01	100·00	Sugar made from the last run of sap in April, from M. J. Smith, Middlefield, Mass.
20	82·07	5·00	9·26	1·16	2·51	100·00	Sugar made from the last run of sap in April, in bulk, from M. J. Smith, Middlefield, Mass.

invert sugar. On the other hand, in many cases the percentage of invert sugar is surprisingly low. These cases indicate that in pure aqueous solutions of sugar heat does not invert the sucrose as rapidly as if mineral salts and organic impurities are present. A study of the proportion of inversion due to heat and to other causes would be of interest. Samples for analysis were purchased in open market, and directly from retail manufacturers. Opportunity was thus afforded to compare the genuine with the commercial articles.

The results of the analyses, presented in the following tables, show to be true what has long been suspected, namely, that the commercial articles are largely adulterated. The commercial syrups are quite uniformly mixed with starch-sugar, or glucose. No method of analysis, however, will detect a kind of adulteration, which is probably common, that of the addition of cane- or beet-sugar to the maple. All of these sugars are identical chemically.

Of the syrups, Nos. 14 to 20, inclusive, are known to be genuine. Excluding from these No. 15, which had been made for more than a year, and had undergone, undoubtedly, partial fermentation, it is seen that the sucrose varies from 39·22 per cent to 64·45 per cent. The invert sugar (glucose), on the other hand, varies from 0·21 per cent to 3·24 per cent. The percentage of water is, as an average, astonishingly large, over 30 per cent.

Of the sugars, Nos. 15 to 20, inclusive, are known to be genuine. In these the sucrose is quite constant, about 84 per cent, while the invert sugar varies between 0·80 and 5 per cent. The water is much higher, too, than one would expect.

Some curious results are shown by the above analyses. Notice, for instance, the difference in syrups Nos. 2 and 3, 4, 5. In case of No. 2 the analysis clearly reveals a large addition of glucose. Nos. 3 and 4 had only a trace of reducing sugar. This is also suspicious. It shows that the samples were made, probably, by adding to a syrupy solution of cane-sugar enough dark maple syrup to give it colour and flavour. It is difficult to suppose that a maple sap evaporated to a thick syrup on an open pan would contain only a *trace* of reducing sugar. No. 4 is a genuine maple syrup.

In Nos. 9 and 10 are also found some interesting data. Both of these syrups are probably genuine, although differing so greatly in composition. If No. 10 is an adulterated sample the admixture is not glucose, but refining molasses. In glucose there is always dextrin and maltose, which were not determined above. In No. 10, therefore, there can be no glucose, else it would partly appear in the undetermined column. On the other hand, the percentage of reducing sugar is very high, indicating a possible addition of refining molasses; but the low percentage of ash in this sample is an evidence of its purity.

In No. 13 is found a sample from the butternut tree (*J. cinerea*). The sap of this tree, taken in early spring, is scarcely inferior to that of the maple.

Unhappily there is no method of detecting the adulteration of maple-sugar with other sucroses. The temptation to this adulteration is great, because maple-sugar commands nearly double the price of other sugars; but neither chemistry nor optics will help to a decision in a question of such an adulteration. If enough of the real maple-sugar is present to give the characteristic odour and flavour the sample must pass.

Lately in the United States a patent has been secured for manufacturing the maple flavour. It is done by extracting hickory bark with water, and the separation and purification of the product. This extract added to glucose or cane-syrups gives them an odour and flavour very like the maple.

HYDROCHLORATE OF COCAINE,

OR MURIATE OF COCAINE.*

Since the short account given in the last pamphlet of the new local anæsthetic, the whole of the writer's available time has been given to the subject, with some results that are worth publication.

The name of the salt brought so suddenly into prominent use has been liberally discussed, and the views of many eminent chemists of the country have been published. The writer is not sufficiently acquainted with the chemical philosophy of modern nomenclature and notation to form an intelligent opinion upon the subject, and therefore has no theory to present in support of any name. The fact that more than twenty good authorities, among whom are some of the most prominent chemists of the country, have given their opinions without any great degree of unanimity, and with the suggestion of five or six different names—shows that there is no universally accepted principle or basis of nomenclature upon which the names of such salts can be accurately constructed; and it farther shows that the names which come nearest to accuracy of expression, according to modern views, are longest, most complex, least convenient and least euphonious, and, therefore, are least adapted to common use. Each hypothesis of the yet unknown construction of the molecule of the salt requires a different nomenclature, and gives room for many well-supported names, but all that can be justly claimed, up to this time, is, that some names are less objectionable than others; and that leaving out those which are least objectionable in point of scientific accuracy, though most objectionable for common usage by reason of their inconvenience, the name Cocaine Hydrochloride is preferred by most chemists. Prof. H. B. Hill, of Harvard, however, says that while he never uses such names as hydrochlorate without mental protest; yet any departure from well established usage is to be deprecated, unless it be to gain very obvious practical advantages. Then, as there is no very obvious practical advantage to be gained from a change, and as most standard authorities give hydrochlorate, the writer prefers to adhere to the established name, especially in view of the expectation that the true construction of the molecule of these salts of the alkaloids with hydrochloric acid will sooner or later be shown beyond question, and this might require a change from any name now adopted. It is, however, certainly time to abandon the very old nomenclature by which such salts are still often called muriates. It may possibly aid the chemists in the study of cocaine to know that it probably has two definite hydrates, and two crystalline salts with hydrochloric acid.

A process by which to obtain a salt of cocaine for use seems now to be of far more importance than a change of name, and it is probable that the salt with hydrochloric acid at present generally used is the best, first, because it forms a salt with the largest proportion of alkaloid, and is easily crystallisable with the smallest proportion of water; and, secondly, because it is very soluble and but slightly, if at all, deliquescent. The salicylate is said to be a very good salt, and solutions of it would be likely to need no protection in keeping, but the high combining number of the acid would give a much weaker salt and one that is probably much less soluble. Therefore, for the present, at least, the hydrochlorate appears to be the preferable salt.

Up to the time of the last note on this subject a modification of the process of Lossen for extracting the alkaloid was found to be least objectionable, but on increasing the scale of its application difficulties were soon met with, and it was found that much of the alkaloid was split up and lost. In short, it was found that this and some other processes yielded more benzoic acid than cocaine, and many losses and disappointments occurred in learning the important lesson that the alkaloid, when set free from its natural combinations in the leaf, was split up, or decomposed at a comparatively low temperature, yielding benzoic acid and an alkaloid or glucoside, or both, that contained no cocaine, or only traces. In the search for less costly solvents than alcohol and ether, it was found that amylic alcohol did very well under certain conditions. The ground or unground leaves, moistened with solution of carbonate of sodium in water, and then dried at very low temperatures, were easily exhausted by means of amylic alcohol, the free alkaloid being very soluble in this menstruum. Moistening with dilute solution of caustic soda, both in water and alcohol, and drying, was tried. These also were easily and probably completely exhausted by amylic alcohol in the cold, but a large quantity of the menstruum was required, and the washing out of the alkaloid by acid water was laborious and troublesome, and gave the alkaloid in a dilute and voluminous solution that was necessarily very acid, since if the water was not strongly acidulated it did not separate well. And if too strongly acidulated it was dissolved to a clear solution by the amylic alcohol.

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* From "An Ephemeris of Materia Medica, Pharmacy, Therapeutics, and Collateral Information." By Edward R. Squibb, M.D., Edward H. Squibb, S.B., M.D., and Charles F. Squibb, A.B.

The advantages, however, were that the alkaloid washed out of the amylic alcohol as a sulphate was comparatively free from colour, giving but little trouble in decolourising, and the amylic alcohol was recoverable by distillation, with a very small loss, and in a perfect condition to be used again. The tedium of drying at so low a temperature, before the exhaustion, and the laborious washing of the percolate, caused the solvent to be abandoned, although it deserved a more careful investigation, and after many other trials and vexatious disappointments and very much loss of time and valuable material, the following modification of the original process of Nieman was reached, and has proved quite successful.

Unmodified, Nieman's process had already failed several times when used on any considerable quantity of material, so that it had been passed as impracticable. His process of assay was also found to be defective, and therefore it is unnecessary to give the process, especially as the steps adopted here from them were not original with him, but were commonly applied to other alkaloids at the time of his investigation. A good abstract of his process may be found in the English edition of "Gmelin's Handbook," vol xvi., page 301.

A convenient scale for the extraction of the alkaloid is to take for each operation 45 kilos. or 100 pounds of the ground leaves, passed through a No. 20 sieve (20 meshes to the linear inch). This powder is moistened with an equal weight of alcohol of about 92·5 per cent, to which has been added one fifty-eighth to one-sixtieth of its weight of sulphuric acid of sp. gr. of 1·483. That is, 12 grains of the acid to each pound of the alcohol. The moistened powder is packed firmly in a stone-ware percolating pot, and the process of re-percolation is applied to it as detailed in " Ephemeris, p. 608, as applied to tea, only that the portion of weak percolate used to moisten the second and every other succeeding portion of 100 pounds is acidulated in the same way that the first portion of alcohol was before it is poured upon the powder. The first or strong percolate of the first two portions may be taken together when they represent about 100 pounds of the powder, and the alcohol recovered from them by distillation for use again in continuing the re-percolations. If the process of re percolation be not applied, but each 100 pounds be exhausted and completed separately, the quantity of alcohol required for complete exhaustion is about five times the weight of the powder, and the loss of alcohol in the process is from 25 to 30 per cent under the best management. But by re-percolation the loss may be reduced to less than 20 per cent. When the alcohol is all distilled off the still is uncovered and 10 pints or 4750 c.c. of water for each 100 pounds of coca represented, is thoroughly mixed with the hot liquid extract. The whole is then transferred from the still to a glass jar and allowed to become cold. It will then have separated into an upper almost black stratum of chlorophyll and other extractive matter insoluble in water, and a lower, watery, acid solution, containing the sulphates of the alkaloids. This watery layer is drawn off by a syphon into a filter, and filtered into a bottle of about three times the capacity of the liquid. The extractive matter is then again washed, by agitation, with about two pints or 950 c.c. of water, and separated as before, the watery portion being added to the first. Add to this about one gallon or 3800 c.c. of stronger ether and then a considerable excess of carbonate of sodium —about 10 ounces or 284 grms. of the crystals for each 100 pounds, or 45 kilos. of coca. Shake this mixture well, allow it to separate, syphon off the lower watery solution, and wash this again by active shaking with a second gallon of stronger ether. Draw off the liquid and repeat the ether washing a third time. Collect the ethereal solution of the alkaloids in a flask placed in a water-bath, and recover the ether for use again. Dissolve the ether residue of alkaloids in water acidulated with sulphuric acid in the proportion of 12 grains to the pound, or 0·17 per cent, using enough to make the solution decidedly acid. Shake this acid solution of the alkaloids with about one-fourth of its volume of stronger ether repeatedly, until the ether comes off colourless, or nearly so. Then precipitate the solution again with carbonate of sodium in the presence of ether, as before, washing the mother waters with ether by shaking in the same way. Collect the ethereal solution again in the distilling flask, and again distil off the ether to about two pints or 950 c.c. to the 100 pounds, or 45 kilos. of coca. Transfer this to tared beaker while hot and set it in a warm place until the remainder of the ether has evaporated, stirring frequently to prevent the crystals from forming in a solid mass or cake. If the crystals be kept in a loose, granular condition by this stirring, they are easily dissolved without much loss of time, but if allowed to form in a solid mass they are very difficult to dissolve. A brownish yellow mass of loose crystals of crude alkaloids will remain, weighing—according to the quality of the coca used—from 100 to 200 grammes to the 45 kilos. or 100 pounds of coca, if the drug has not been below a fair quality, as determined by an assay before being bought. Pour on to this mass of crystals about half its volume of water, and then add concentrated sulphuric acid in the proportion of about 12 c.c. to each 100 grms. of crystals, with constant stirring until the crystals are dissolved, and the solution is very slightly acid. Then dilute the solution to about five times the weight of the crystals.

Then arrange a cylindrical percolator of such capacity as to be about half-filled by a weigh of moist, purified, and well-washed bone-black equal to the weight of the crude alkaloid, and filter the solution through this at a rate not faster than about ten to fifteen drops per minute,—the slower the rate the more perfect the decolourisation will be. But the bone-black used must be of good quality,—and of such quality as it is almost impossible to get without making it. The writer is very much indebted to his friend Mr. P. Casamajor for lifting him out of the bone-black Slough of Despond. Good effective bone-black must be pure carbon in the peculiar state of agregation given by the burning and washing. It should be perfectly black in colour, and when boiled with dilute solution of caustic potassa should yield a colourless supernatant liquid. If not well burned the liquid will have a brown tint. Burned from a platinum foil it should leave no residue, or merely traces. It should be in fine powder, and after being well washed, first with hydrochloric acid and then with water, it need not be dried, but simply be drained and kept in a moist state for use. Bone-black bought in the market at 1 dollar per pound, and labelled chemically pure, proved very inefficient until re-burnt; whilst good sugar-house bone-black when re-burnt and washed was much more effective. For decolourising so valuable an alkaloid the bone-black must be simply pure carbon, for that absorbs the smallest amount of the alkaloid, and gives up no foreign matter to the solution filtered through it, and the solutions subjected to its action should be rather dilute,—say, one in five, and be either neutral or slightly acid. The solution should come through this percolator quite colourless at first, and when all through and the black washed clean with about four times its volume of water, the entire solution and washings should be not deeper than a full straw-colour. This will be the result if the bone-black be of good quality, and in an active condition; but it is worthy of note that a bone-black may answer the tests by caustic potassa and by burning without residue, and yet have a very feeble decolourising power. The bone-black after use is not thrown away, as it contains much alkaloid, which can be extracted by digestion and agitation with carbonate of sodium solution and ether. By the use of a larger quantity of black the whole solution might be obtained colourless, but the loss by the use of bone-black is very considerable and is proportionate to the quantity used, and the farther decolourisation is not, at this time, worth the cost of obtaining it, because the colouring matter is inert and unirritating, and when in so small a proportion as to give only a yellow colour it does not practically affect the weight of alkaloid. The dazzling whiteness of some salts of the alkaloids, such as those of morphine and quinine, is very beautiful, but desirable only from an æsthetic point of view, since it adds nothing to the effects of the salts. Indeed, the processes by which it is attained are often, if not generally, damaging to the alkaloids.

When the solution has all passed through the black, and the latter has been washed with about four times its volume of water by percolation, the whole decolourised solution and washings are collected in a bottle, and solution of carbonate of sodium, one part crystals in five of solution, is added, a small portion at a time, with active shaking between the additions, until the contents of the bottle remain permanently quite opaque from precipitated alkaloid, requiring about 30 c.c. of carbonate of sodium solution to the 100 grms. of crude alkaloid. This first precipitation consists mainly of the useless and inert alkaloid,—the hygrine of the coca, and to separate it the opaque solution is actively shaken with one-sixth to one-eighth of its volume of stronger ether. This dissolves all the precipitated alkaloids,—cocaine as well as hygrine, but a large proportion of the ether is dissolved by the watery solution, and this portion probably holds a share of the alkaloids. The ethereal solution is then separated, and the ether washing repeated, using about half the quantity of ether the second time. These ether washings separate the hygrine imperfectly under the best management, but are practically sufficient until some better plan can be devised. But when they separate it most perfectly they also take with it a portion of cocaine, and therefore they are kept for another process of solution and separation when they have accumulated. The solution of sulphate of cocaine, now sufficiently freed from hygrine, is then transferred to a precipitating jar, and the carbonate of sodium solution is slowly added to it, with constant active stirring until a small portion of mother-liquid filtered off gives no cloud on adding a drop of the precipitant. The whole is then well stirred, and allowed to stand over night. The clear supernatant liquid is then drawn off into one or more bottles, which are about half-filled with it, and the precipitate is collected on a filter and well washed with water until the washings come off tasteless. This washing is more effective when the clean washed upper stratum of the precipitate is taken off two or three times as the washing proceeds. The mother-liquor and washings collected in bottles are washed twice, each time with about one-eighth of their volume of stronger ether to recover the alkaloid retained in them. The ether from these washings is recovered by distillation, and the alkaloid, amounting to about 0·1 p.c. of the total quantity precipitated, is carried on to the next portion. The washing of the precipitated alkaloid is only carried on until the washings come off tasteless or nearly so. Of course, they might be carried farther, or until they give no reaction for either sulphuric acid or sodium, but this would involve a practically useless loss of alkaloid, since it is not quite insoluble in water. The washed magma is then spread upon a flat-bottomed drying vessel or tray and dried at a very low temperature, say, not over 50° C. = 122° F.

In drying, the cake breaks up into white, light, porous fragments, somewhat resembling heavy magnesia. This is a hydrate and carbonate of the alkaloid cocaine, containing more or less of the inert hygrine, according to the management, and in this condition it is kept for conversion into any salt that may be desired. When the hydrochlorate is to be made from it, a portion is put into a shallow evaporating vessel,—flat-bottomed, if possible,—and is just moistened with water. Strong hydrochloric acid is then added cautiously, in small portions, with constant stirring until the alkaloid is exactly saturated, and this solution is then evaporated at a low temperature. Managed in this way, the evaporation is reduced to a minimum, and in a proper flat vessel takes but little time in heating. The evaporation is allowed to go on spontaneously until a thick pelicle is formed on the surface. When this is broken up by stirring, the solution is a perfectly transparent syrupy liquid of a full light yellow colour,—not colourless,—of about the consistence of ordinary varnish, which it much resembles. Often, on being disturbed by the stirrer, and always after a little stirring, the whole mass suddenly crystallises in very small crystals, with the evolution of a gas supposed to be carbonic anhydride, forming an opaque, pasty, semi-liquid mass. This is then stirred constantly until it is entirely dry—and it is known to be dry when it can be rubbed up and passed through a sieve No. 40. Of the perfectly dry hydrate of the alkaloid 100 parts yield about 114 parts of the dry hydrochlorate.

The net yield of either alkaloid or salt from any given lot of coca cannot, as yet, be accurately stated, becauses the several residues cannot well be worked up separately. First, there is the chlorophyl and extractive matter which contains some alkaloid, and is, therefore, not thrown away, but is set aside for farther working. Then the alkaline solutions, after the ether washings, all contain alkaloid, most of which appears to be held there by the dissolved ether. Then there is the very valuable proportion that is washed out with the hygrine, making, altogether, a residuary proportion which, by rough estimate, may amount to 2 p.c., that is recoverable, though at considerable expense for ether, time, and labour. The yield of crude mixed alkaloids, is always easily obtainable, since they are dried in order to get at the proporation of solvents and bone-black needed in the purification. But these crude alkaloids yield very differently to the process of purification, as they contain more or less hygrine and products of decomposition. Occasionally they have not yielded more than one-half the weight of the crude alkaloids, while occasionally the loss seems to be not over 20 p.c. A longer experience, with better coca, is required before any very definite account of net yield can be given; yet it is very apparent that all the cocas worked give a considerably larger yield than was indicated by the old process of assay, and by the first experience in the extraction.

One lot of 164 pounds or 74,545 grms. yielded 319 grms., or very nearly 0·427 p.c. of crude alkaloids, and about 0·34 p.c. of the finished salt. This was a lot of young and very green leaves, and cost 1 dol. 50 cents per pound. It appeared to be very good coca, though evidently not mature. Gathered when too young, but well cured and well-packed.

Another lot of 280 pounds or 127,272 grms. yielded 409 grms. of crude alkaloid or 0·321 p.c. and about 0·27 p.c. of finished salt. This was a lot of mature leaves, not green, but of very fair quality of the brownish grades, the best that could be selected in the New York market within the past three months. This lot was bought before the rise in prices, and cost 65 cents per pound.

These two lots were worked after a little experience with the above given process, and represent the best results attained at this writing, though two or three other lots of green coca gave somewhat similar results,—whilst four smaller portions were entirely lost in reaching the process.

The above given process does not pretend to be a very good one, but only the best that could be reached by the writer in two months or more of close and unremitting application to the subject. Those more familiar with the extraction and purification of the sensitive alkaloids may all have better processes for this one, but if they have, they have not published them. It is, at least, an effective working process, yielding a very good alkaloid in considerably larger proportion than was expected from any coca now accessible, and a larger proportion than is given in any published account of the extraction, and it is expected that with farther experience and improvements in the details, the net yield will be still farther increased, especially when better coca is attainable. But it is an expensive process in solvents, time, labour, and apparatus, and, from the value of the product, is especially risky by breakage and incidental losses. The actual loss of alcohol by the process is not short of 20 gallons to the 100 pounds of coca, and of stronger ether about 12·5 pounds, making, in these two items alone, a cost of not less than 54 dollars per 100 pounds of coca for these heavily taxed solvents, which in other countries, or in this, without the alcohol tax, would not cost more than one-sixth of that, or 9 dollars per 100 pounds of coca.

(To be continued).

PROCEEDINGS OF SOCIETIES.

PHYSICAL SOCIETY.

Annual General Meeting, February 14th, 1885.

Prof. Guthrie, President, in the Chair.

Prof. G. Fuller was elected a member of the Society.

The President then read the report of the Council, in which the Society was congratulated upon the number of original communications read, 43 during the past year. Among the works undertaken by the Society may be mentioned the publication of the first volume of "Joule's Scientific Works." A second volume containing accounts of researches conducted by Mr. Joule in conjunction with other scientific men would be published shortly.

The Treasurer presented a highly satisfactory report.

The Council for the ensuing year was then elected, the result of the election being as follows:—President—Prof. F. Guthrie, Ph.D., F.R.S. Vice-Presidents who have filled the office of President—Dr. J. H. Gladstone, Prof. G. C. Foster, Prof. W. G. Adams, Sir W. Thomson, Prof. R. B. Clifton. Vice-Presidents—Profs. W. E. Ayrton, Shelford Bidwell, Lord Rayleigh, Prof. W. C. Roberts. Secretaries—Prof. A. W. Reinold and Walter Bailey. Treasurer—Dr. E. Atkinson. Demonstrator—Prof. F. Guthrie. Other Members of Council—C. Vernon Boys, C. W. Cooke, Prof. G. Forbes, Prof. F. Fuller, R. T. Glazebrook, Dr. J. Hopkinson, Prof. H. McLeod, Prof. J. Perry, Prof. J. H. Poynting, Prof. S. P. Thompson. Hon. Member, Prof. M. E. Mascart.

The customary votes of thanks to the Committee of the Council of Education, and to the President, Secretaries, and other officers having been passed, the meeting resolved itself into an ordinary meeting of the Society.

Miss Marks described "*A New Line and Area Divider.*" This instrument consists of a hinged rule with a firm joint. The inside edge of each limb is bevelled and presents a straight edge. One limb is divided on both edges into a number of equal parts, and is fitted by a groove on its outer edge to a plain rule along which it can slide. To divide a line into a given number of equal parts, the hinged rule is slid along the plain rule till the nth division from the joint is opposite a fixed mark on the plain rule; it is then placed on the paper so that the nth division on the graduated straight edge coincides with one end of the given line, and then opened till the straight edge on the inner edge of the other limb passes through the other extremity. The plain rule is then pressed firmly down and the hinged rule slid along it. As each division of the graduated edge passes the fixed mark, the intersection of the moving edge with the given line is marked, and thus the line is divided into "n" equal parts. The instrument may be used in this way to draw any given number of equidistinct parallel lines between two given points. It may be conveniently used in working out indicator diagrams and measuring areas.

Mr. Walter Baily described certain improvements made in his integrating anemometer, which has been previously described. The improvements consist in the substitution of mechanical counters for electrical ones, as it was found in the recent observations with the instrument at Kew that the extra friction of the "contact" was sometimes sufficient to stop the motion. The mechanical counters were found to work satisfactorily in every respect.

Prof. Guthrie showed some specimens exhibiting the similarity of fracture of Canada balsam and glass. The glass had been cracked by heating a metal ring to which it was attached; the Canada balsam had been overheated in a small dish and allowed to cool.

NOTICES OF BOOKS.

Year-book of Pharmacy: comprising Abstracts of Papers relating to Pharmacy, Materia Medica, and Chemistry, contributed to British and Foreign Journals from July 1st, 1883, to June 30th, 1884; with the Transactions of the British Pharmaceutical Conference at the Twenty-first Annual Meeting, held at Hastings, August, 1884. London: J. and A. Churchill.

This volume contains a large collection of very valuable matter arranged under the customary heads. The classification of the abstracts seems still, however, capable of improvement. A paper on the applicability of the nettle fibre in textile manufactures and in paper making seems out of place in the section "Materia Medica and Pharmacy." The same may surely be said concerning the abstract of Mr. E. C. C. Stanford's researches on the economic applications of seaweed, and of a most interesting paper by Mr. A. W. Bennett on the white sewage fungus (*Beggiatoa alba*). The author quotes from Luerssen's "Die Kryptogamen"—here misprinted Kroptogamen—the important statement that it inhabits thermal sulphur springs, as those of the Alps and Pyrenees, Aix-la-Chapelle, &c. The author himself has seen it in large quantities on waste-ground about alkali-works at Jarrow-on-Tyne. Hence he concludes that it has "the power of extracting sulphur not only from decomposing organic matter, but also from mineral sulphates dissolved in the water." He does net regard it as a certain indication of partially decomposed sewage, though it must be taken "as evidence of the presence of an abnormal amount of sulphates," which may be derived directly from sewage or from substances used in precipitating it, or from manufacturing operations. But there is no reason to believe that it has any injurious effect on the water.

In a paper on the relative antiseptic power of certain chemical agents it is stated that 0·07 part of mercuric chloride is as efficient in preventing fermentation and putrefaction in solutions of animal matter as 3·20 of carbolic acid. The use of boric acid in the preservation of food is called in question on the evidence of facts observed by J. Forster. Even in small doses it materially increases the proportion of solid matter and of nitrogen in the fæces, and augments the discharge of albuminous matter from the intestinal canal.

The process for the manufacture of carthamine, quoted from "New Remedies," is not the one which is used by manufacturers of this beautiful dye, which dispenses with the use of cotton.

A foreign journal circulating among soap manufacturers is quoted as saying that a small addition of starch to soap "cannot be considered as an adulteration, and indeed for some purposes it is of a certain advantage, as in the treatment of wool and silk." But if manufacturers require starch for any purpose they would surely find it best to buy it separately at something less than 1d. per lb.

In the Presidential Address delivered at the Conference we find reference to the interesting fact that certain artificial or synthetic compounds have not quite the same physiological action as the supposed identical bodies of a natural origin. As instances are mentioned the benzoic, cinnamic, and salicylic acids. Possibly it may have to be admitted that the living organism can differentiate compounds which to our subtlest analysis appear identical. After summarising certain recent researches on the production of starch in plants under specified conditions, the President raised the question whether there are not times and conditions when and under which plants are more vigorous and the activity of their medicinal principles is intensified ?

In a discussion on the growth of Belladonna and Hyoscyamus, Mr. Atkins informed the meeting that "In his own neighbourhood some plants would grow on one side of a hedge and not on the other, and often on the side where he should not have expected them to grow,—where they got the afternoon sun, not the morning. Two or three years ago, when at Vevey, he was told by a large vine-grower that the grapes which had the afternoon sun produced a wine of much higher quality than the vines which had the morning sun." These facts bring into question, if not the accuracy, yet the universality, of the common assumption that the morning sun exerts a specially beneficial action upon vegetation.

We further notice the intelligence that the seeds of *Strychnos nux vomica* from Ceylon contain the exceptionally high proportion of 5·34 per cent of total alkaloids.

CORRESPONDENCE.

ABSOLUTE ETHER.

To the Editor of the Chemical News.

Sir,—Allow me to point out two very serious mistakes which occurred under above heading in the Chemical News, vol. li., p. 67.

0·0124 (expansion for 11°) divided by 11, is equal to 0·00112, and not 0·00127 as given. Unfortunately this is not a mere misprint, as I find in all the calculations given this wrong factor haa been used. I have re-calculated the numbers with the following results :—

Dumas and Boullay ..	0·713	20°C.	0·7186
Saussure and Thénard	0 7155	,,	0·7211
Gay-Lussac	0·7119	25°	0·7231
Kopp (Gmelin)	0·73658	0°	0·71978
—— (others)	0·73568	,,	0·71888
Watt and Wurtz ..	0·723	12·5°	0·7202
Mendelejeff	0·73644	0°	0·71964
Allen	0·7185	17·5°	0·7213
Allen	0·713	15°	0 713
Roscoe and Schorlemmer	0·73568	0°	0·71888
Roscoe and Schorlemmer	0·7024	15°	0·7024

The author of the article referred to takes Allen's number, 0·7185 at 17·5°, and finds it equivalent to 0·71532 at 15°, which, to quote his own words, is "of course exactly wrong, since the density diminishes by expansion through increase of temperature." This error is the more peculiar since he points out that Allen made a similar mistake in his "Commercial Organic Analysis." In 1881, while studying chemistry under Prof. Dittmar, F.R.S., I prepared and examined pure ether (as a *student's* chemical *exercise*) and found the following numbers then and there :—

Spec. grav. at 15° C. 0·7197 ; water at 4=1.
*Boiling-point 34·75° C. at 755 m.m.
Vapour density 37·05 H=1.—I am, &c.,

Alex. Buchan.

Glasgow, Feb. 13, 1885.

CHEMICAL ACTION ATTENDING EFFLUX FROM A CAPILLARY TUBE.

To the Editor of the Chemical News.

Sir,—With reference to an interesting paper read by Mr. R. S. Dale before the Manchester Literary and Philosophical Society, on "Some Novel Phenomena of Chemical Action attending Efflux from a Capillary Tube," and quoted in the Chemical News (vol. li., page 58), a series of experiments of a *somewhat* similar nature were carried on in Mr. L. Reed's Laboratory, and were published in the *Engineer* of July 10th, 1883.

The following generalisation which was drawn from these experiments may be worded as follows :—

"When one liquid is allowed to pass into another through a capillary outlet, the effluent stream is influenced by three distinct forces.

Cohesion between the molecules of the entering liquid causes this to remain within the narrowest limits of volume compatible with the nature of the circumstance. *Adhesion* acting between the molecules of the entering liquid and those of that entered tends to spread the former in the latter; in other words, to disperse the former. *Gravity* causes the molecules of the effluent liquid to rise or fall in the liquid entered in direct proportion to the difference between the specific gravities of the two liquids.

"If at the same time an interchange can take place between the *atoms* of the two liquids, that is, if chemical action can take place, we know that adhesion will aid and cohesion prevent.

"Hence, the motion of the molecules resulting from the action of these three forces is of a twofold nature.

Gravity tends to move the fluid *en masse*. *Cohesion* and *Adhesion* tend to give a motion of rotation to the liquid molecules by the friction of one liquid against the other. This twofold motion, then, is *general* and *internal*.

"*Now this is the motion of the vortex ring.*"

I think, sir, that this generalisation is to some extent verified by Mr. Dale's experiments, which will doubtless prove of great value in future lecture experiments.—I am, &c.,

Thomas Hart, Assoc. R.S.M.

The E.C. Powder Works, Stone,
Green Street Green, near Dartford.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

Note.—All degrees of temperature are Centigrade unless otherwise expressed.

Zeitschrift für Analytische Chemie.
Vol. xxiv., Part 1, 1885.

Determination of Starch in Barley and other Grain.—H. Bungener and L. Fries.—The authors extract with a 1 per cent solution of salicylic acid in water at 100°.

Examination of Water.—A number of proposed methods from the Chemical News, the *Analyst*, the *Amer. Chem. Journal*, and the *Comptes Rendus*.

Analysis of Milk.—M. Schmöger.—It is maintained that poor milks, containing less than 2 per cent of fat, do not yield it entirely to ether unless evaporated with gypsum. Both gypsum and filter-paper were found, however, to give up a small quantity of matter to ether.

Determination of the Acidity of Beer, Wine, Wort, Malt, and Yeast.—Adolph Ott points out that both in beer and wine exact neutralisation is impossible as the reaction soon becomes amphoteric.

The Graduation of Baumé's Hydrometer.—From the *American Chem. Review*.—It is to be regretted that the proposal of the American Association of Manufacturing Chemists is about to increase the existing confusion by making 66° Baumé = 1·835 sp. gr., whilst it is elsewhere assumed = 1·842 and even = 1·815.

The Use of Boric Acid in the Preservation of Articles of Food.—J. Forster.—From a series of experiments the author concludes that boric acid, as an addition to human food, either somewhat interferes with the utilisation of some of the nutritive constituents, or gives

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* Coef. of expansion 0·00104 per 1° C. (0°—20°.)

rise to an increased separation of cellular particles from the lining of the intestinal canal, and to an augmented secretion of mucus. Hence it is by no means so harmless an agent as it is commonly assumed.

The Composition of Honey and its Sophistications.—W. Lenz.—Solutions of pure honey from flowers never occasion a deviation smaller than −6° 30′. If starch, sugar, &c., be added the solution is rendered less lævo-rotatory or even dextro-rotatory.

Blue Colour of Cheese from Centrifugal Milk.—M. Schmöger.—This phenomenon is traced to the presence of a little iron in solution.

Presence of Copper in Cereals.—E. F. Willoughby.—From the *Analyst.*

Determination of Dry Matter in Malt.—Adolf Ott.—The moisture of malt is entirely removed by heating to 100° in a current of dry air or hydrogen.

A Peculiar Kind of Rice Starch.—U. Kreusler and F. W. Dafert.—The starch of *Oryza glutinosa* gives with a sufficiency of iodine a brownish red-colour.

The Fermentative Power of Yeast.—E. Meissl and C. Ventin.—A critique on the methods of Hayduck and Meissl.

Determination of the Specific Gravity of Coke, its Porosity and the Proportion of Solid matter.—C. Reinhardt.—This memoir cannot be reproduced without the three accompanying illustrations.

Determination of Alkalies in Urine.—Th. Lehmann.—The author takes 100 c.c. (or in case the spec. gravity exceeds 1·020 only 50 c.c.) mixes with 3 to 4 grms. ammonium sulphate, evaporates to dryness in a platinum capsule holding 60 c.c., and incinerates. If the ash is not purely white it is moistened with a few drops of sulphuric acid, dried, aud again ignited. The residue is dissolved in hot dilute hydrochloric acid, the residue filtered off and washed, the precipitate is precipitated with baryta-water, and further treated in the usual manner.

Detection and Determination of Ammonia in Animal Liquids.—J. Latschenberger.—The author mixes the liquid in question with an equal volume of a cold saturated solution of copper sulphate, adds baryta-water until neutral litmus-paper is no longer affected by a drop of the liquid, and tests the colourless filtrate with Nessler's solution. Recent urine of men or of dogs gives a dark brown precipitate, as does cow's milk, the blood of oxen a brown colouration, and the gall of oxen a yellow colour.

Detection and Determination of Acetone in Urine.—C. le Nobel and F. Penzoldt.—An examination of existing methods.

Chemico-Legal Detection of Certain Vegetable Matters.—The substance of this long and important paper will be inserted as early as possible.

Determination of Urea with Bromine Solution.—H. J. Hamburger.—The reagents required are :—1. Bromine water obtained by dissolving 30 grms. solid sodium hydroxide in 1 litre water, shaking it up with 20 c.c. bromine, and filtration through asbestos. 2. A 4-10th normal solution of arsenic (containing per litre 19·8 grms. arsenious acid and 10·6 pure sodium carbonate). 3. A decinormal solution of iodine in potassium iodide. In performing the operation 10 (or 20) c.c. of the urine are cautiously mixed with bromine-water until the escape of gas has ceased; 1, 2, or 3 c.c. of bromine-water are then added in excess, and after the lapse of 5 to 10 minutes the arsenical solution is added until the solution becomes a light yellow. It is then necessary to test whether potassium iodide starch-paper is no longer turned blue by the liquid, and 3 c.c. of arsenius solution are then added in excess. Carbonic acid is then passed through the liquid, about 20 c.c. of soda solution are added along with a few drops of starch paste, and the excess of arsenious acid is determined with solution of iodine.

MISCELLANEOUS.

Royal Institution.—Mr. Carl Armbruster will begin a course of five lectures on "The Life, Theory, and Works of Richard Wagner," on Saturday, February 28th (with vocal and instrumental illustrations).

Properties of Genuine Vinegar.—B. F. Davenport.—In Boston vinegar is considered spurious if it contains less acid than corresponds to 5 per cent acetic anhydride. Cider-vinegar, dried at 100°, must leave not less than 1·5 per cent of normal dry residue.

MEETINGS FOR THE WEEK

MONDAY, 23rd.—Medical, 8.30.
— London Institution, 5.
— Society of Arts, 8 (Cantor Lectures.) "The Chemistry of Pigments, by J. M. Thomson, F.R.S.E., F.C.S.
TUESDAY, 24th.—Royal Institution, 3. "Museums and National Education," by Prof. S. Colvin.
— Institution of Civil Engineers, 8.
— Royal Medical and Chirurgical, 8.30.
— Society of Arts, 8. "The Spanish Gold-Fields and the Mines of Rio Sil," by William Sowerby.
WEDNESDAY, 25th.—Society of Arts, 8. "Past and Present Methods of Supplying Steam-boilers with Water," by W. D. Scott Moncrieff, M. Inst. C.E.
— Geological, 8.
THURSDAY, 26th.—London Institution, 5 and 7.
— Royal, 4.30.
— Royal Society Club, 6.30.
— Royal Institution, 3. "The New Chemistry," by Prof. Dewar.
— Society of Arts, 8. "Tempered Glass," by Dr. Frederick Siemens.
FRIDAY, 27th.—Royal Institution, 8. "A Marine Biological Laboratory," by Prof. E. Ray Lankester, at 9.
— Quekett Microscopical, 8.
SATURDAY, 28th.—Royal Institution, 3. "Richard Wagner," by Mr. C. Armbruster.
— Physical, 3. "Notes on the Use of Nicol's Prism," by James C. McConnell.

THE CHEMICAL NEWS
AND
JOURNAL OF PHYSICAL SCIENCE.

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THE CHEMICAL NEWS.

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NOTE ON THE SEPARATION OF METALS PRECIPITATED BY HYDROCHLORIC ACID.

By JOSEPH BARNES.

Although we do not expect the methods generally given for "qualitative separation" to possess a great degree of accuracy, still we look upon them as being capable of giving us some idea of the relative amounts of the ingredients in a mixture, or at any rate of indicating the presence of more than traces of a substance. It may not generally be known that the method which is almost invariably given for the separation of silver from mercurosum by the action of ammonia on their chlorides does not even fulfil the requirements of a qualitative separation: if the mercurous chloride predominates largely scarcely a trace of silver chloride can be extracted by means of ammonia, and in any case the mercury compound always retains a large quantity of silver, as the result of the following simple experiment proves:—

A mixture containing 1·183 grms. crystals of mercurous nitrate and 0·330 grm. silver nitrate was treated with cold hydrochloric acid. The precipitated chlorides, after being washed with boiling water, were treated for some time with cold dilute ammonia solution, then with stronger ammonia (0·96 sp. gr.); the residue was finally digested with warm ammonia.

After concentrating the ammoniacal filtrates only 0·021 grm. AgCl was obtained therefrom. The residue insoluble in ammonia gave on treatment with aqua regia 0·252 grm. AgCl.

I may here take the opportunity of drawing attention to a strange error in the method described in many text-books (*vide* "Fresenius' Qualitative Analysis") for the detection of tungstic acid when precipitated along with silver, &c., by the addition of hydrochloric acid. It is directed that the residue left after removing the silver with ammonia should be examined for tungstic acid. It is, perhaps, needless to say that the failure which would attend this process depends upon the easy solubility of precipitated tungstic acid in a solution of ammonia.

CARBIDES OF PLATINUM FORMED AT COMPARATIVELY LOW TEMPERATURES.

By A. B. GRIFFITHS, Ph.D., F.C.S. (Lond. and Paris), Lecturer on Chemistry and Physics, Technical College, Manchester.

There is a memoir in a recent number of *Comptes Rendus*, detailing some researches on the silicides of platinum, by MM. Schützenberger and Colson. They have found that when platinum is heated in a forge-fire in contact with pure carbon, *i.e.*, by lining an earthenware crucible with "retort-carbon," and platinum placed inside this lining, the platinum easily melts when the crucible is exposed to a white heat for an hour or two in a wind furnace. They say, after cooling, the fused button has increased in weight, due to taking up silicon, which, according to the authors, has penetrated in the form of vapour through the walls of the interior lining.

It has long been known that carbon and silicon both combine with platinum when they are heated together by means of the oxy-hydrogen blowpipe. But, long before MM. Schützenberger and Colson's paper was published, I tried several experiments on fusing platinum in contact with carbon at *comparatively low temperatures*. Many of my scientific friends can testify to these experiments, and my pupils in the Metallurgical Laboratory of the Technical College, Manchester, have known of my experiments for some months. I have not worked upon the subject since those experiments were performed, for my mind has been of late occupied with researches belonging to agricultural and physiological chemistry.

The experiments alluded to are as follows:—The small clay crucibles (the same as are used by iron assayers, consisting of one part of burnt clay and two parts of raw clay) are brasqued in the ordinary way with charcoal; pieces of platinum-foil placed in these charcoal linings; and then the lid of each crucible luted on with the mixed clay. The crucibles are now fastened to half a brick (by luting with clay), and then placed on the grate of an ordinary metallurgical laboratory furnace,* a fire made of anthracite coal, and the crucibles exposed to the full heat of this fire for one hour and a half, *without any blast* whatever. Then they are taken out of the furnace while hot and allowed to cool slowly.

On breaking open the crucibles globules of platinum were obtained, and the platinum completely fused. In these experiments the platinum-foils were weighed before the experiment, and the globules of platinum afterwards, with the following results:—

Weight of Platinum in Grammes.

Before.	After.
3·520	3·554
6·592	6·670
3·520	3·560
6·592	6·668

So, it will be seen, that in these four experiments that there is an increase in weight of the platinum after heating. When these fused platinum globules were treated with nitro-hydrochloric acid (aqua regia) and boiled, the platinum dissolves, leaving a number of small black specks, which float on the surface of the acid. Taking up one or two of these small black specks on the point of a needle, and examining them under the microscope, they were seen to consist of hexagonal plates which mark paper: they are insoluble in a mixture of nitric and hydrofluoric acids, thus showing that the molten platinum had taken up carbon, and this carbon exists (wholly or partially) in the platinum in the graphitoidal form.

Beyond these points I have not investigated the subject. The experiments prove:—

1. That platinum, the most infusible of metals, can be fused at comparatively low temperatures without a blast, when in contact with carbon.
2. That the carbon is taken up in small quantities, and crystallises from the molten platinum, when slowly cooled, in the graphitoidal form.
3. That the affinity of platinum for carbon is greater when the metal is in the molten condition; for the carbon separates in the crystalline plates on cooling, showing that it must have been dissolved in the molten platinum.

The Modifications Produced in the Chemical Composition of certain Animal Fluids by the Influence of Epidemic Cholera.—Gabriel Pouchet.—The bile contains a notable proportion of albumen. Leucine, tyrosine, glucose, and fatty globules mixed with crystals of fatty acids, and cholesterine, were also present. The excrements contained a relatively high proportion of urea and of sodium chloride. The ptomaine present is very rapidly reduced on treatment with a mixture of potassium ferricyanide and ferric chloride. The author and his assistant suffered from incipient poisoning in consequence of inhaling the vapour of the ptomaine. Scatol was not present in the excretions, a fact alreaey observed by Brieger in case of persons suffering from typhus.—*Comptes Rendus.*

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* Our furnaces here are like those in the Metallurgical Laboratory of the Royal School of Mines, London.

LONDON WATER SUPPLY.

Report on the Composition and Quality of Daily Samples of the Water Supplied to London for the Month ending January 31st, 1885.

By WILLIAM CROOKES, F.R.S.,
WILLIAM ODLING, M.B., F.R.S., F.R.C.P.,
Professor of Chemistry at the University of Oxford.
and C. MEYMOTT TIDY, M.B., F.C.S.,
Professor of Chemistry and of Forensic Medicine at the London Hospital; Medical Officer of Health for Islington.

To Colonel Sir Francis Bolton, *Water Examiner, Metropolis Water Act*, 1871.

London, February 10th, 1885.

Sir,—We submit herewith the results of our analyses of the 189 samples of water collected by us during the past month, at the several places and on the several days indicated, from the mains of the seven London Water Companies taking their supply from the Thames and Lea.

In Table I. we have recorded the analyses in detail of samples, one taken daily from January 1st to January 31st inclusive. The purity of the water, in respect of organic matter, has been determined by the Oxygen and the Combustion processes; and the results of our analyses by these methods are stated in Columns XIV. to XVIII.

We have recorded in Table II. the tint of the several samples of water, as determined by the colour-meter described in a previous report.

In Table III. we have recorded the oxygen required to oxidise the organic matter, and the quantities of free oxygen present in the whole of the samples submitted to analysis.

Of the 189 samples examined, the whole were found to be perfectly clear, bright, and well-filtered.

In our previous report, that for December, we were able to speak of the quality of the water supplied during the month, in respect to the smallness of the proportion of organic matter present, as being good, and as not differing appreciably from that taken note of in the preceding months. There being some amount of discrepancy between this statement and that made in the Report to the Registrar-General, we have, during the past month, taken care to verify the results of our daily full analyses of the water, by having each analysis performed in duplicate. Our results, thus obtained, agree closely with those of last month, and manifest the continued excellence in quality of the water. Thus, the mean quantity of organic matter in the water supplied by the Thames' Companies during the month of December was found to be 0·151 part, and the maximum quantity in any one sample 0·179 part, in 100,000 parts of the water; while the mean quantity in the Thames-derived water supplied during the past month was 0·137 part, and the maximum in any one sample 0·182 part, in 100,000 parts of the water. This maximum quantity of 0·182 part of organic carbon would correspond to a little over three-tenths of a grain of organic matter per gallon.

We are, Sir,
Your obedient Servants,
William Crookes,
William Odling,
C. Meymott Tidy.

Society of Arts.—The second of the course of Cantor Lectures at the Society of Arts on "The Chemistry of Pigments," by J. M. Thomson, F.C.S., will be given on Monday, March 2, at 8 p.m. The first lecture dealt with the nature and division of colours, the deleterious actions on white pigments, and methods for counteracting the same. The second lecture will be devoted to an examination into the chemistry of coloured pigments, and of certain organic and special pigments.

HYDROCHLORATE OF COCAINE,

OR MURIATE OF COCAINE.*

(Continued from p. 92).

The coca that has been accessible in any of the markets within the past three months has all been of low quality, and very variable, some of it yielding no alkaloid at all, though not differing in appearance from others that yielded in fair proportion, so that it has not been safe to buy without a previous assay of samples, and hence a good assay process became very important. The writer soon found that the process given at *Ephemeris*, p. 604, was not a good one, and it had to be abandoned. The two lots of coca, the details of which are given above, when assayed by the process alluded to, gave respectively only about 0·19 and 0·16 p.c., but by a new process now to be given they gave much higher results which were in fair practical accord with those obtained in working on the large scale.

This new process of assay is based upon the process of manufacture, and is as follows:—

Take 50 grms. of the sample after being powdered and passed through a sieve of 60 meshes to the linear inch. Moisten the powder with an equal weight of alcohol of 92 p.c., to which has been added one-sixtieth of its weight of sulphuric acid sp. gr. 1·843. Allow the moistened powder to stand in a covered vessel for 3 or 4 hours, and then pack it firmly in a cylindrical percolator. Percolate it with alcohol,—not acidulated,—until 250 c.c. of percolate have been obtained. This percolation is very much facilitated by the use of a Sprengel water-pump such as is used in laboratories for rapid filtration. Without this pump the percolation is slow and will require a day and a night. With the filter-pump three hours is sufficient. Evaporate the alcoholic solution in a shallow broad capsule at a low temperature until it is reduced to about 10 c.c., and then add to this 25 to 50 c.c. of water, applied in two or three portions, carefully washing out all that is soluble in water from the clots of chlorophyll and resinous extractive matter. Filter the solution into a flask or separating apparatus, add to it an equal volume of stronger ether, shake vigorously, separate the solution, add half its volume of ether, and again separate the solution. Add to this an equal volume of ether, and then solution of carbonate of sodium in excess, and shake vigorously. When now the liquids separate a drop of the solution of carbonate of sodium should produce no cloud in the lower stratum of liquid. Separate the ethereal portion, put it into a tared beaker, wash the watery liquid with half its volume of ether, and add the ether to that in the beaker, and set this in a warm place until the ether is all evaporated off. Then pour upon the residue in the beaker 5 c.c. of water, rinse it round well, without a stirrer, and having poured it off, dry the contents of the beaker, weigh, and subtract the tare. The net weight is the crude alkaloids with much colouring matter. On an average a deduction of 20 to 25 p.c. of this weight will give a close approximation to the cocaine contained in the sample.

Allowing the moistened powder to stand 3 or 4 hours allows the powder better to absorb the menstruum, but it is not an important step, since the amount of percolate prescribed completely exhausts the coca without the digestion, if the powder be as fine as is directed and the percolation well managed. The washing of the acidulated solution of alkaloids from the alcohol residue is an important step, as the soft, green, resinous clots are liable to retain a portion of the alkaloids. The preliminary washing of the acid solution with ether removes a considerable proportion of colouring matter, which, if left in, would be taken up by the ether with the precipitated alkaloids and vitiate the results, while the ether takes little alkaloids from the acid solution. It doubtless takes some alkaloid

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* From "An Ephemeris of Materia Medica, Pharmacy, Therapeutics, and Collateral Information." By Edward R. Squibb, M.D. Edward H. Squibb, S.B., M.D., and Charles F. Squibb, A.B.

in the water which it dissolves, and the use of ether previously saturated with water would avoid this slight loss. The alkaloids precipitated by the carbonate of sodium are at once dissolved by the ether, and a small portion of the mother-liquor is also dissolved, which might be avoided by the use of water-saturated ether. In separating the liquids closely, which has to be done several times, an elongated pear-shaped separatory, with a stop-cock at the small end, and a cork at the large end, is very convenient, and these, when used in pairs, drawing off from one to the other, give very rapid work and accurate results. It is necessary to evaporate off the ether from a beaker, because if a capsule be used the creeping over the edge involves serious loss and the washing out of the extractive from the residue is impracticable. The alkaloids are left in the beaker in small varnish-like drops on the sides, and a varnish-like film at the bottom, but in a half-hour or an hour of drying the drops generally become star-shaped crystals, and the film at the bottom also crystallises, but these crystals when touched are found to be sticky, and no amount of drying that the alkaloid will stand is of any avail to dry them farther.

If there be any haste this assay can be easily made by one person in six or eight hours if the filter-pump be used, and in a day and a night if the digestion of the moist powder be made, and the percolation be well managed without the pump.

The rationale of the assay process, as well as the process of manufacture, is very simple, and is based on the following conditions:—

The alkaloid cocaine, when free, is very easily split up and destroyed by even a moderate degree of heat, and this destruction is materially aided by the presence of alkalies and other chemicals. It is also easily destroyed by heat, &c., when in its natural combination in the leaf, but less easily than when in the free state. But when made decidedly acid it is freely soluble in alcohol in the cold, and when in alcoholic solution, in this acid condition it bears the heat necessary to distil off the alcohol with but little if any destruction or damage. The alkaloid is soluble in all proportions in stronger ether, while its sulphate and hydrochlorate are not soluble in ether. It can therefore be completely washed out of its ethereal solution by acidulated water, and can also be easily washed out of its watery solution by precipitation in the presence of ether. The solution of its salts in water can be completely precipitated by carbonate of sodium, without the liberation of carbonic acid, but a considerable proportion of the precipitated hydrate of the alkaloids is held in solution in the mother-waters whether these contain either sulphate or chloride of sodium. But this portion of alkaloid can be completely washed out by ether.

The hydrated alkaloid cocaine, from the above process, is in light, white spongy fragments, or in light amorphous powder very much like magnesia. It is not perfectly white, but very nearly so. It is nearly insoluble in water, but very soluble in acids, giving solutions that are not quite colourless. When a very small particle is laid upon the tongue, and the tongue then held against the roof of the mouth, a moderately bitter taste is perceived in a few seconds. In a few seconds more the bitterness gives place to a numbness and insensibility of the surfaces, as though scalded by hot liquid, except that there is no pain. This numbness increases for a few minutes, and then diminishes slowly, and disappears in ten to twenty minutes in proportion to the quantity applied.

The hydrochlorate of cocaine from the above process is an almost white crystalline powder, though the fragments of crystals are so small that it appears to be an amorphous powder, even under a glass of low power. The powder when dry is loose and mobile, but when exposed to damp air becomes a little damp and clammy, although it does not appear to be deliquescent. It is soluble in all proportions in hot water and in alcohol, and in somewhat less than half its weight of water at ordinary temperatures. Its solutions are not colourless, but appear to be nearly so when seen in small phials, even up to the strength of 20 per cent. Solutions of 50 or 60 per cent strength are, however, even in small phials, of a greenish-yellow tint. The solutions are neutral to test-paper. When tested with solution of chloride of barium they give, after a moment or two, the faintest cloud (limit of sulphates). With test-solution of oxalate of ammonium the result is negative (absence of lime). When the salt is burnt off a platinum surface, there is merely a trace of residue (limit of inorganic matter). And the spot moistened with water scarcely affects the colour of neutral litmus-paper (limit of inorganic alkalies). A test is very much needed to control the proportion of hygrine and other inert matter admissible, but as yet this has not been found.

The solutions are all liable to deteriorate by the growth of microscopic plants, which are nourished by the alkaloid, and therefore destroy it. These growths commence usually within a week, and when once started they increase rather rapidly. As the salt will always be used in solution, and as many persons will not take the time and trouble for even so small a matter as the making of accurate solutions, it becomes highly important to fix upon a definite standard strength of solution for ordinary uses, and to have this securely protected against change in keeping. There are several agents which prevent these growths in alkaloid solutions, and among the most effective are carbolic acid, salicylic acid, boric acid, and the aromatic series. A small proportion of ether often prevents the growths, and as this seemed least objectionable here, it was tried, but failed, until the proportion was so large as to be irritating to mucous membranes. All the protective agents are somewhat irritant even in dilute solution, and in selecting the one which seemed least irritant, and which was effective in the smallest proportion, salicylic acid was adopted. An incidental objection to this acid is its extreme sensitiveness to the presence of very minute traces of iron. Almost all filtering paper contains iron enough to react with salicylic acid, and in handling extracts, alkaloids, &c., it is not easy to avoid the use of steel spatulas, tinned iron funnels, &c. Hence it is, that a very nearly or quite colourless solution of hydrochlorate of cocaine, when mixed with a very dilute solution of salicylic acid, will, either at once or in a few hours, in proportion to the amount of iron present, become very sensibly deeper in tint, and of a reddish brown tint. As no possible harm can come from this tint, and as a tinted solution is just as good as a colourless one, this objection to salicylic acid was not considered of sufficient weight to cause it to be rejected. Boric acid seemed to be a much better protective agent, in that its effects upon mucous membranes, —of the eye, for example, are not at all irritant, but, on the contrary, are sedative. But it is a much less certain protective, and is required in so much larger a proportion than salicylic acid, that it was not thought safe to adopt it.

At ordinary temperatures 1 part of salicylic acid is held in solution by about 300 parts of water, and it is good practice to keep such a solution standing upon some undissolved crystals for use in protecting solutions of the alkaloids for hypodermic and general use. In making up the solutions of alkaloids, a good rule is to take one-half water and the remainder of the solution of salicylic acid, as the solvent. This gives to the solution of the alkaloid salt about one six-hundredth part of salicylic acid,—a proportion that can hardly be objectionable in any way, and yet is sufficient to protect the solutions indefinitely.

In the ordinary uses of hycrochlorate of cocaine, common usage seems to have fixed upon a strength of 4 per cent as being at the same time sufficiently effective, and economical in regard to waste. It is more irritating on first application than a 2 per cent solution, and less irritating than stronger solutions, but from greater concentration it is more prompt in effect, is less liable to spread over broad surface and be diluted by secretions, and less liable to waste by overflow, in the increased quantity required. Hence it is more than twice as effective as a 2 per cent solution, and, therefore, more economical in cost as well as in time and promptitude of action. Beside, when a 2 per cent solution is preferred, or a 1 per cent solution is required for therapeutic purposes, these can be easily made from the 4 per cent by dilution with water. Of course an equal number of drops, from the same dropping tube, of 4 per cent solution and of water, make a 2 per cent solution. And 1 drop to 3 of water makes a 1 per cent solution.

In making a very accurate 4 per cent solution of course it should be done by weight. Of the salt 1 part, of water and solution of salicylic acid each 12 parts. But weighing is not necessary in ordinary practice. It is quite sufficient to dissolve each grain of the salt in 12 minims each of water and solution of salicylic acid, or the contents of each 5 grain phial of the salt in 60 minims each of water and solution of salicylic acid; or, each 1 gramme phial in 12 c.c. each of water and solution of salicylic acid. That is, the salt makes 25 times its weight of 4 p.c. solution, or 50 times its weight of 2 p.c. solution, and minims and grains are, perhaps, near enough to equality in value for rough usage. At least this is the best that can be done by those who reject the metric system. All solutions of alkaloid salts should be filtered through paper, because it is almost impossible to avoid particles of dust in the salt and solvents.

The 4 per cent solution, when protected by salicylic acid, gives a faint but very distinctly acid reaction with test-paper. It is scarcely affected by test solution of chloride of barium, but gives a dense precipitate with test-solution of nitrate of silver. An ordinary dropping tube or pipette, such as is used in eye practice, delivers drops of just about half a minim. or 0·031 c.c. One such drop is 3⅓ fluid-ounces, or 100 c.c. of distilled water, gives in a 10 c.c. test-tube a distinct cloud with a single drop of test-solution of iodide of mercury and potassium. The cloud is barely perceptible on very close observation in a dilution of 125 c.c., and this appears to be the limit.

A piece of bibulous paper 6 millimetres or a quarter of an inch square will hold about the twentieth of a drop or the fortieth of a minim. This, when laid upon the tongue, and the tongue then applied against the roof of the mouth, should, in a minute or less, give a strong numbness to both surfaces.

The salt is put up in phials of 5, 10, 15, 20, 30, and 60 grains each, and the 4 per cent solution in phials of 1, 2, 4, and 8 fluidrachms. The phials of the salt, when properly protected, can go through the mails, but the solution cannot, as liquids are absolutely excluded from the mails by law.

The demand for both the salt and the solution has been so very active, and the production so limited, that the prices have remained very high up to this time, and it is said that the scarcity of good coca from which to make them, is likely to continue until the new crop is ready in May. Even moderately good coca, is now held at 80 cents to 1 dollar 25 cents, while for some 1 dollar 50 cents demanded, and it is about as scarce and high, and the quality about as poor in Europe as it is here, but that this condition can be maintained until May the writer doubts, since high prices for an article which is produced in such abundance commonly brings it from unexpected and unusual sources. Merck, of Darmstadt, has until very lately been the principal maker. He has advanced his price three or four times, and has supplied a very small proportion of what has been ordered from him, and he now announces that he can get but a limited supply of coca, and will be able to supply even less than before. At least five manufacturers in this country announce that they are making it in considerable quantities and are supplying all their orders. The price here and in England is about 50 cents per grain for the hydrochlorate of cocaine, and 10 dollars per fluid ounce for the 4 per cent solution. But there has been a preference for Merck's salt, which, with its scarcity, makes it bring now about 85 cents per grain. As long as the demand remains so active, and coca so scarce and high, these prices may possibly be maintained, since if one manufacturer gets ahead of the others either in supply of coca or in his process of manufacture, he will still maintain his price as long as he can market his product at it. But with a fair supply of coca, at even full prices, there is no reason for any such prices. Any one who puts his prices down now will simply have his stock rapidly exhausted and be unable to supply his orders, but there is really no other reason why the salt should not be sold at less than half the present prices. With a supply of good coca accessible, this writer would be glad to make it at 15 or 18 cents per grain, even with the high cost of solvents, by the above given process, and it is to be hoped that such a supply of coca is not many months off. The cost of extracting and purifying the alkaloid at present is perhaps not over 1 dollar 20 cents per pound of coca leaves, and if the leaves cost, say 80 cents, the total would be about 2 dollars per pound. Then if the yield of alkaloid be 0·27 per cent or 19 grains to the pound, equal to about 21 grains of the hydrochlorate, the net cost would be about 10 cents a grain, and 15 cents would then be a fair selling price, considering the character and quality of the work on it. This estimate, however, does not take into account the time, skill, and expenditure of material in getting a good working process, which, in this instance, to the writer, has been several hundred dollars; nor does it take in the probability that farther experience may lessen the cost of production. A much more moderate demand for the salt is also to be expected as the excitement about it diminishes, and the absurd misuses to which it is applied are abandoned, and this will aid very much in moderating the prices. And, for the best interest of the agent, it is by no means desirable that they should be maintained.

A new agent of such importance is very rarely so suddenly found, and it is not wonderful that it should produce much excitement, and be much abused, through the temporary enthusiasm in regard to its application, but it is to be hoped that this excitement will not last much longer, and that some of the failures and demerits, if there be any, will be heard of. It is certainly being very widely used, in very considerable quantities, all over this country, for all sorts of purposes, rational and irrational, and a most important experience with it must be rapidly accumulating. In illustration of how recklessly and empirically it has been applied, statements are published of its internal use in typhoid fever, diphtheria, scarlatina, and other diseases, and with alleged success, notwithstanding that all this ground of therapeutic uses internally has been gone over long ago with negative results. Locally for anæsthetic purposes it has been applied to the skin for the excision of tumours, and by hypodermic injection around parts to be incised, and generally with a published success that it is impossible to comprehend, except as results of enthusiasm. Many such published successful applications repeated in other hands have failed entirely, or almost entirely, whilst others,—and these the more rational—have often failed of the complete success claimed for them.

There have been a very large nnmber of papers in the journals upon its applications and their advantages, and many conservative writers have given their testimony and experience in regard to its importance, without enthusiasm. Such papers are becoming more common of late, and they are doing much to abate the excitement and lessen the demand.

(To be continued.)

The Manufacture of Soda in Germany.—R. Hasenclever.—From 1862 to 1882 the production of sulphuric acid in Germany has increased from 22,311 tons to 157,961 tons, chiefly obtained from Siegen pyrites. Lump pyrites are burnt in kilns with movable grates, and smalls in Perret or Maletra kilns. The burnt ore from certain mines is afterwards smelted for iron, but the Siegen ore retains too much sulphur to permit of its use in metallurgy. M. Hasenclever seeks to refute the views of Dr. Lunge on the inconvenience of zinc sulphide (blende) in the manufacture of sulphuric acid.—*Moniteur Scientifique.*

PROCEEDINGS OF SOCIETIES.

CHEMICAL SOCIETY.

Ordinary Meeting, Thursday, February 19, 1885.

Dr. W. H. Perkin, F.R.S., President, in the Chair.

Messrs. G. S. Bowler, T. R. Duggan, A. G. Green, W. W. J. Nicol, W. F. Pankhurst, T. A Rickard, F. Rindskoff P. C. Thomas, and H. H. Whitehead, were formally admitted Fellows of the Society.

Certificates were read for the first time in favour of Messrs. George Harrison Genmell, 13, Peel Street, Liverpool; William Benjamin Hards, St. John's College, Battersea; Thompson Muskett, Walton Lane, Stanley Park, Liverpool; and Robert Elliott Steel, Spring Cliffe House, Heaton Road, Bradford.

The President declared that the following changes in the Council were recommended to the Society:—

As President: Dr. Hugo Müller, F.R.S., vice Dr. Perkin, F.R.S.

As Vice-Presidents: Mr. W. Crookes, F.R.S., and Prof. W. A. Tilden, F.R.S., vice Dr. Voelcker (deceased) and Dr. Griess, F.R.S.

As Foreign Secretary: Dr. F. R. Japp, vice Dr. Hugo Müller.

As Ordinary Members of Council: Prof. F. Clowes, Mr. A. E. Fletcher, Prof. G. C. Foster, F.R.S., and Mr. Ludwig Mond, vice Dr. Japp, Dr. Hodgkinson, Mr. D. Howard, and Prof. Schorlemmer.

Mr. R. H. Davis, Dr. P. F. Frankland, and Mr. Makins were appointed to audit the Treasurer's accounts.

The President announced that Mr. Warren de la Rue, F.R.S., had presented a bust of the late Prof. Dumas.

The following papers were read:—

10. "*On Benzoylacetic Acid and some of its Derivatives.*" Part II. By Dr. W. H. Perkin, jun.

Referring to Part I. of his research, the author states that the substituted benzoylacetates may be purified by distillation under reduced pressure. *Ethylic ethylbenzoylacetate* and *allylbenzoylacetate*, as thus purified, are described. An account of further experiments on the hydrolysis of these bodies is given: it was not found to be possible to prepare the corresponding acids from them in a pure state, benzoic acid being also produced, in some cases in very considerable proportions, even if only dilute alcoholic potash solution were used; more encouraging results were obtained with the ethyl-derivative on using concentrated sulphuric acid as hydrolytic agent, and a quantity of pure benzoylacetic acid was prepared from ethylic benzoylacetate by means of this reagent.

Ethylic benzoylisonitrosoacetate,—

$$C_6H_5.CO.C(N.OH).COOEt$$

(? *benzoylhydroximodoacetate*), prepared from nitrous acid and ethylic benzoylacetate, crystallises in long colourless needles melting at 120° to 121°; it easily dissolves in alkalies, forming a yellow solution; it decomposes when distilled, becoming carbonised, and hydrogen cyanide is produced. Contrary to expectation, when submitted to the action of a dilute aqueous solution of potassium hydroxide, it does not furnish isonitrosoacetophenone, but instead a crystalline body, which apparently has the formula $C_9H_8O_4$, is produced.

Ethylic dibenzoylacetate, $CH(CO.C_6H_5)_2.COOEt$, is formed by consecutive treatment of the benzoylacetate with sodium ethoxide and benzoyl chloride. Dibenzoylacetic acid prepared from it by treatment with alcoholic potash, &c., melts at 109°; when rapidly heated in small quantities a part distils unchanged, but the greater part is resolved into carbon dioxide and *Dibenzoylmethane*. Its aqueous solution is coloured a dirty-red by ferric chloride. It slowly dissolves in solutions of ammonia, sodium hydroxide, and sodium carbonate; several of its salts are described. It is converted by boiling with dilute sulphuric acid into methylphenylketone, benzoic acid, and carbon dioxide. Experiments made with the object of converting ethylic dibenzoylacetate into the tribenzoylacetate by consecutive treatment with sodium ethoxide and benzoyl choride appear to indicate that such a body may be formed in this manner.

Dibenzoylmethane crystallises from alcohol in flat rhombic plates, measurements of which are given. It melts at 81°; it is easily soluble in alkalies. By consecutive treatment with sodium ethoxide and benzoyl chloride it is converted into *Tribenzoylmethane*, $CH(CO.C_6H_5)_3$. This latter compound crystallises from hot alcohol in almost microscopic needles, melting at 224° to 225°; it is easily soluble in an alcoholic solution of potassium hydroxide.

Phenyllactic acid, $C_6H_5.CH(OH).CH_2.COOH$, obtained by reducing ethylic benzoylacetate with sodium amalgam, &c., crystallises from benzene in aggregates consisting of fine needles melting at 93° to 94°; a crystalline body of the empirical formula C_5H_4O is produced together with it.

It is remarkable that on submitting ethylic benzoylacetate to the action of phosphorus pentachloride a chlorocinnamic acid of the formula $C_6H_5.CH.CCl.COOH$ is produced; the reaction therefore is one involving isomeric change.

If a mixture of ethylic benzoylacetate and benzaldehyd, cooled to 0° be saturated with hydrogen chloride, a reaction gradually takes place similar to that observed by Claissen in the case of ethylic acetoacetate, *ethylic benzalbenzoylacetate*, $C(CH.C_6H_5)(CO.C_6H_5).COOEt$ being formed. This body crystallises from ether in large monoclinic prisms, measurements of which are given; it melts at 98°. Attempts to hydrolyse it with muriatic acid and with alcoholic potash gave negative results.

11. "*On Toughened Filter-paper.*" By E. E. H. Francis.

Filter-paper which has been immersed in nitric acid, rel. den. 1·42, and washed with water, is remarkably toughened, the product being pervious to liquids and quite different from parchment-paper made with sulphuric acid. Such paper can be washed and rubbed without damage, like a piece of linen. The paper contracts in size under the treatment, and the ash is diminished; it undergoes a slight decrease in weight, and contains no nitrogen. Whereas a loop formed from a strip 25 m.m. wide of ordinary Swedish paper gave way when weighted with 100 to 150 grms., a similar loop of toughened paper bore a weight of about 1·5 kilo. The toughened paper can be used with the vacuum pump, in ordinary funnels without extra support, and fits sufficiently closely to prevent undue access of air, which is not the case with parchment-paper. An admirable way of preparing filters for the pump is to dip only the apex of the folded paper into nitric acid and then wash with water; the weak part is thus effectually toughened.

12. "*The Detection and Estimation of Iodine.*" By Ernest H. Cook, B.Sc. (Lond.)

The usual tests for iodine when existing as an iodide are rendered somewhat difficult by the circumstances that nitrous acid liberates bromine as well as iodine, while if an excess of chlorine be employed, colourless chlorides of bromine and iodine are formed. These difficulties become of importance when it is desired to detect small quantities of iodides in the presence of comparatively large quantities of bromides, or when a quantitative estimation is to be made of the iodine.

To avoid these difficulties, the author proposes to use hydrogen peroxide, which is added to an acetic acid solution. Under these circumstances the whole of the iodine is separated from the iodide, while bromides and chlorides are unaffected.

Details of the methods of employing the test for qualitative and quantitative purposes are given; in the latter case the iodine is extracted by means of $CHCl_3$, the solution is washed with a little water to remove hydrogen peroxide, and the titration of the iodine then performed in the usual manner.

DISCUSSION.

Mr. **Groves** said that he had very successfully used nitrous acid in determining small quantities of iodine in presence of much chlorine.

Dr. **Japp** did not know that the method described was better than the old well-known process of adding titrated chlorine water in presence of carbon bisulphide until the colour of the iodine disappeared, which took place when 5 atomic proportions of chlorine to 1 of iodine had been added.

Mr. **Groves** had found this latter a far less convenient process.

Dr. **Stevenson** spoke to the same effect, and said that he also had found the nitrous acid method satisfactory.

13. "*Note on Methylene Chlor-iodide.*" By Prof. J. **Sakurai**.

This compound was obtained by heating methylene iodide with iodine chloride; it is a colourless oil, which boils at 109° to 109·5°, of relative density (referred to water at the same temperature) 2·447 at 11° and 2·444 at 14·5°. It is identical with the substance previously obtained by the author from mercuric methylene chlor-iodide and iodine (*Trans.*, 1882, p. 360), and it is therefore concluded that this mercuric compound has the formula $CH_2Cl.HgI$.

14. "*A Quick Method for the Estimation of Phosphoric Acid in Fertilisers.*" By J. S. **Wells**, Columbia College.

Finding the ammonium molybdate method too long and tedious when many analyses of fertilisers had to be done, the author has adapted Joule's citric acid method as a gravimetric process. He employs two solutions: A, consisting of citric acid 900 grms., ammonia solution (rel. den. 0·92) 1400 c.c., water 500 c.c.; and B, a strong solution of magnesium citrate. 1 grm. of the fertiliser is fused with sodium carbonate and nitrate, dissolved in nitric acid, and the silica filtered off. To the filtrate some of solution A is added, and the whole allowed to stand for half an hour; enough of solution B is then added to precipitate the phosphoric acid. For the author's experiments, a test solution was made up of sodium phosphate, calcium chloride, and ammonia-iron alum, so as to contain P_2O_5, 19·83 per cent, CaO, 25 per cent, Fe_2O_3, 3 per cent; equal portions were taken for analysis, the comparison of his results with theory being given in a table. He compares his own method with the ammonium molybdate method on several fertilisers with the following results:—

	Ammonium Citrate Method.	Ammonium Molybdate Method.
1.	4·23 per cent	4·23 per cent
2.	18·36 ,,	18·18 ,,
3.	3·42 ,,	3·64 ,,
4.	14·01 ,,	13·92 ,,

DISCUSSION.

Mr. **Riley** did not think the method described a simple one. He stated that he had been working on a process which he hoped would enable him to easily determine phosphoric acid in a substance like basic iron cinder, which contained about 19 per cent. The cinder is dissolved in nitric acid and taken up with alcohol, the alcohol being then evaporated off, and the phosphoric acid titrated with uranium nitrate. He had not yet been altogether successful, however.

Mr. F. J. **Lloyd** said that the accuracy of the results would depend on and would vary with the kind of material examined. A very similar method had already been published, the essential feature in it being that the lime was not taken out; after making many experiments on this method for Dr. Voelcker, he was led to conclude that it was not possible to obtain accurate results with different substances.

15. "*On the Luminosity of Methane.*" By Lewis T. **Wright**, Assoc. M.I.C.E.

Pure methane was prepared by Gladstone and Tribe's method by the action of the copper-zinc couple on methyl iodide. The gas was obtained free from methyl iodide vapour by passing it through tubes fixed in a horizontal position and packed with copper-zinc, which was kept moistened with alcohol, the alcohol vapour being removed by scrubbing with sulphuric acid. It was burned in a London Argand burner, the chimney of which was fitted with a cap for the purpose of limiting the air supply to the quantity most favourable to the development of luminosity. The methane flame was compared with a Methven Standard burner supplied with 18-candle gas, *i.e.*, with a light equal to two sperm Parliamentary candles. The results obtained were—

Rate of consumption per hour corrected to 60° F. and 30″ B. cub. ft.	Candles observed.	Candles per 5 cub. ft. per hour calculated.
2·78	2·9	5·20
4·46	4·6	5·15

The author proposes to extend his observations to ethane and propane.

DISCUSSION.

Mr. **Lloyd** doubted the accuracy of the Methven Standard.

Dr. P. F. **Frankland** asked whether the author had analysed the gas; the results obtained appeared to him to be too high. He had found that the methyl iodide was not all removed even after bubbling the gas through fifteen bulbs containing antimony pentachloride. The method adopted for developing the maximum illuminating power of the methane was extremely interesting.

Dr. **Armstrong** thought that the method of removing methyl iodide adopted by the author was more likely to be successful than that described by Dr. Frankland; it was well known that air laden with sulphuric anhydride could be bubbled through a very long column of water without the removal of the anhydride being effected.

16. "*On the Oxides of Nitrogen.*" By Prof. W. **Ramsay** and J. **Tudor Cundall**.

In this research it is shown—

1. That the green or blue liquid obtained by the action of arsenious anhydride on nitric acid consists of a mixture of nitrous anhydride and nitric peroxide, in proportions depending on the strength of the nitric acid and the temperature at which the volatile liquid is condensed.

2. That if a dehydrating agent, such as sulphuric acid, be present in sufficient quantity, the distillate consists of pure peroxide, and that this process is by far the most convenient one for the preparation of the peroxide.

3. That if oxygen be passed over the blue liquid, the vapours condensed in a freezing-mixture are still blue or green; a great excess of oxygen is necessary to effect conversion from nitrous anhydride into peroxide.

4. That when excess of nitric oxide is passed along with the peroxide into a cooled bulb the trioxide is produced, the amount of trioxide depending on the temperature of the condenser.

5. The vapour-density of a liquid of a deep blue colour, containing about 30 per cent of trioxide and 70 per cent of peroxide, shows that the trioxide cannot exist in the gaseous state, but at once dissociates into nitric oxide and peroxide on changing to gas. The theoretical vapour-density of such a mixture was calculated from a formula deduced from the second law of thermo-dynamics by I. Willard Gibbs, which shows the relations between, temperature, pressure, and vapour-density of the mixture of NO_2 and N_2O_4 in the gaseous peroxide; and it was found that the vapour-densities of a mixture of $(NO_2+N_2O_4)$ (partly present in the original liquid as peroxide, partly formed by the decomposition of the N_2O_3 present into NO and $(NO_2+N_2O_4)$) with the NO produced by the de-

composition of the N_2O_3, calculated by means of Gibb's formula, are identical, within limits of experimental error, with those obtained by direct experiment.

6. The presence or absence of moisture does not appear to affect the reaction between NO and O_2.

7. It is probable that N_2O_3 undergoes dissociation with rise of temperature, even while liquid.

DISCUSSION.

Dr. **ARMSTRONG** said that he had listened to the paper with great interest, as he had made numerous experiments on the subject, and had long been of opinion that N_2O_3 did not exist, at all events as gas. The authors' observations, whereby they were led to this conclusion, were of considerable importance, and it was to be hoped that ere long confirmatory evidence that would more directly appeal to chemists would be forthcoming. It was noteworthy that there was no recorded evidence proving the existence of N_2O_3 as gas. Gay-Lussac's experiments, published in 1816, showed that nitric oxide and oxygen only reacted in the proportions to form N_2O_4, and that reaction in proportions corresponding with the production of N_2O_3 only took place in presence of alkali.

The method adopted by the authors did not suffice to prove the existence of N_2O_3, even as liquid, and their results could be equally well interpreted on the assumption that they were dealing with a solution of NO in N_2O_4. It was to be expected that N_2O_4 would be a good solvent of NO, as it appeared to be the rule that bodies which are related are easily miscible, phosphorus, for example, being very soluble in PCl_3, and sulphur in CS_2 and S_2Cl_2. One observation made by the authors did, however, support their view, viz., the observation that the blue liquid was with great difficulty oxidised by passing oxygen into it.

In all his experiments, Dr. Armstrong had found that the reactions attributed to N_2O_3 could be equally well effected by a mixture of N_2O_4 and NO. As to the action of arsenious oxide on nitric acid, in his opinion, *nitrous acid* was *the* product, and the manner in which this underwent change entirely depended on the conditions. In dilute solution NO would be produced in accordance with the equation: $3HNO_2 = 2NO + HNO_3 + H_2O$; but in presence of nitric acid the reaction $HNO_2 + HNO_3 = N_2O_4 + H_2O$ would take place, and would more and more preponderate the less the amount of water present. The addition of sulphuric acid would of necessity favour the latter mode of change. When N_2O_4 is passed into sulphuric acid nitrosyl sulphate and nitric acid are formed; in presence of NO the latter is reduced to nitrous acid, which also forms nitrosyl sulphate with the sulphuric acid, so that a mixture of NO and N_2O_4 in proper proportions precisely acts as though it were N_2O_3.

Mr. **GROVES** said that in preparing nitrosyl sulphate he had found that very little was formed when very concentrated nitric acid and arsenious oxide were used to produce the nitrous gas; and that it was difficult to reduce the solution of HNO_3 in H_2SO_4 by NO.

Dr. **WRIGHT** mentioned that he recollected the late Mr. Chapman telling him that he had come to the conclusion that N_2O_3 did not exist as gas, but he did not know what experiments he had made on the subject.

Prof. **RAMSAY**, in reply, said that he thought the production of a blue liquid on passing a colourless gas into a brown liquid was good evidence of the production of a distinct compound. (Peligot's experiments render it highly probable that the blue colour results from the introduction of traces of water.—H. E. A.) Numerous cases could be cited of the non-existence of compounds as gas which were well known as liquids or solids—chloral-hydrate, for example.

At the next meeting of the Society on Thursday, March 5, there will be a ballot for Fellows.

UNIVERSITY COLLEGE, LONDON,
CHEMICAL AND PHYSICAL SOCIETY.
Thursday, February 19, 1885.

C. E. CASSAL, F.I.C., F.C.S., President, in the Chair.

A PAPER was read by F. W. KROHN on "*Some Phenomena in connection with Dust.*" After briefly describing Tyndall's observation of a dark dust-free plane rising from a heated rod in a smoky atmosphere, and Lodge's and Clark's observation that this plane was part of a dust-free *coat* torn off by convection currents, the lecturer stated the various theories which had been proposed for the explanation of the phenomenon, and tried to show, by citing various experiments, that the molecular bombardment theory as elaborated by Lodge (in a paper, *Phil. Mag.*, 5th series, vol. xvii.) was the one which gave the most satisfactory explanation. Lord Rayleigh's observation of a dust-free plane descending from a cool body in a warmer smoky (dusty) atmosphere, though similar in appearance, probably belonged to a different class of phenomena to those previously cited, and could be explained as being due to the removal, by downward convection currents of the air, underneath the body, which had been purified by the gravitative settling of the dust particles. Aitken had shown that if the body was very much colder than the air the plane and clear space under the body tended to become narrower. This was probably not only due to the increased velocity of the downward convection currents, but also to the tendency of the dust particles to be driven on to the cold body by molecular bombardment. Some few of the phenomena of dust-free coats round hot bodies, in an atmosphere containing smoke compounds of ammonium chloride or similar substances, were shown, from experiments of Aitken's, to be due to evaporation or disintegration. The lecturer concluded by explaining and showing some of the phenomena observed when an electric discharge takes place from a jet into a smoky atmoshere.

SAMUEL RIDEAL, *Hon. Sec.*

ROYAL DUBLIN SOCIETY.
February 16th, 1885.

THE only original papers of chemical interest read at the last meeting of this Society were two.

Mr. **JOLY** described a method of taking the specific heat of solids by measuring the weight of water condensed by the solid when hung up in an atmosphere of steam. The method, Mr. Joly said, gave great accuracy, and it might be used with great advantage in identifying minerals, by thus ascertaining their specific heat.

Mr. H. N. **DRAPER** exhibited a new apparatus for the production of sulphuretted hydrogen. This paper has appeared in CHEMICAL NEWS, vol. l., p. 292. The author recommends that a little warmth should be used in connection with the ammonium-sulphide bottle—it worked more regularly under such circumstances.

VIENNA ACADEMY OF SCIENCES.

AT the meeting of the Academy on December 4th, Prof. **EDER** communicated a memoir on the "*Behaviour of the Haloid-Silver Compounds with the Solar Spectrum and on the Increase of their Sensitiveness to Certain Portions of the Spectrum by means of Colouring-Matters and other Substances.*" The author employed a large Steinheil spectrograph. The image of the spectrum is thrown upon the sensitive plate by means of a photographic objective of 54 m.m. aperture and 600 m.m. focal distance.

The image of the spectrum is 12 c.m. long from A to N. He employed also a small Steinheil spectrograph provided with a direct vision spectroscope, allowing but little of the ultra-violet to pass through, and therefore throwing the maximum action of the spectrum upon salts of silver further towards the visible spectrum. The maximum action of silver and chloride gelatine was in the large spectrograph at H, but in the small one between F and G. An emulsion of silver bromide gelatine had, in the large spectrograph, its maximum of sensitiveness at G $\frac{1}{2}$ F. Silver bromide, precipitated in a strong solution of gelatine, and digested for a short time, gives at the same place an intense blackening with alkaline pyrogallol developer, which sinks rapidly towards ultra-violet and green. After prolonged digestion, especially in a weak solution, the sensitiveness increases, and the curve representing the spectral action flattens strikingly and extends further towards yellow. Silver iodide-silver bromide gelatine, when recently mixed, displays two maxima, one between H and G, and another between G and F. After prolonged digestion both these maxima coalesce in one. Silver iodide-silver chloride also gives two maxima. The author further discusses the action of colouring-matters upon the gelatine emulsions of silver bromide, iodide, bromo-iodide, and chloro-iodide. Of the 140 colouring-matters examined a part only were sensitisers for the absorbed rays, namely:—Hofmann's violet, dahlia, primula, iodine violet, methyl violet, Paris violet, benzyl-rosaniline violet (methyl violet 6 B), gentiana violet, acid violet, resorcine blue, and especially cyanine for orange, the maximum being between D and C; acid green, malachite green, ethyl green, methyl green, and iodine green for red, the maximum at C; eosine (both brom- and iod-), and the kindred colours, erythrosine, Bengal rose, methyl eosine, ethyl eosine, phloxine, cyanosine, aureosine, and safrasine for yellowish green and yellow, especially if ammonia is added, the maximum being between D and E; magenta, red coralline, naphthaline red, for yellow to yellowish green, but more faintly than eosine. Coupier blue produces two maxima of sensitiveness, one in the green and the other in the orange. Fluoresceine, chrysoline, and chrysaniline for the green, approximating closely to the normal spectral image on silver bromide gelatine; saffranine, ponceau, Biebrich scarlet, and grenadine have a faint action for green and yellow; hæmatoxyline, turmeric, and soluble Prussian blue slightly for yellow to red without a distinct maximum.

Coloured silver iodobromide and iodochloride have the same action as coloured silver bromide and chloride, the maximum action being in the yellow.

The analysis of silver bromide, separated centrifugally from gelatine emulsion, showed that a small quantity of gelatine (0·5 per cent) and of colouring matter cannot be removed.

According to the author the anomalous dispersion of colouring matters and fluorescence are not connected with the sensitising action as little as their spontaneous decomposition in light or their absorption in adhesive matters. The author calls the loss of light due to the absorption of light and its conversion into heat, photo-thermic extinction, and the loss of light by conversion into chemical work, photo-chemical extinction.

The photo-chemical extinction of a mixture is determined in many cases by the photo-thermic extinction of one of its constituents. If the mixture of a coloured body of strong elective absorbent power with another of small absorbent power is decomposed in the light, the rays of that wave-length which are absorbed by the former with photo-chemical extinction come principally into action, and thus the maximum of photo-chemical decomposition in the spectrum is determined by the former. If the substance of slight elective absorptive power possesses, *per se*, a decided sensitiveness, its decomposition in light becomes more or less manifest along with that effected by the more strongly absorptive substance.—*Chemiker Zeitung.*

NOTICES OF BOOKS.

The Patentees' Manual: being a Treatise on the Law and Practice of Letters Patent, especially intended for the Use of Patentees and Inventors, with an Appendix of Statutes, Rules, and Foreign and Colonial Patent Laws, International Conventions, and Protocol. By James Johnson, of the Middle Temple, Barrister-at-Law, and J. H. Johnson, Solicitor, Assoc. Inst. C.E. Fifth Edition, thoroughly revised, incorporating the Patent Act of 1883. London: Longmans, Green, and Co., and Stevens and Sons.

This work, though well known in technical circles, has been, as a matter of necessity, very much modified in consequence of recent legislation. The authors, it will be observed, do not express any opinion as to what a patent law should be, which, considering their wide and prolonged experience, might have been valuable. Nor do they pronounce decidedly as to the policy or the impolicy of the alterations in patent law and patent practice which are due to the Act of 1883. They consider, indeed, that these changes have stimulated the inventive talent of the nation, seeing that during the first nine months of 1884 the applications for patents were 13,012, as against 4656 in the corresponding portion of 1883. It is, of course, to be expected that a reduction of the initial cost of a patent from £25 to £4 would enable certain inventions to receive protection which otherwise might have remained a secret. But it must not be forgotten that under the old law a patent often included several inventions, each of which will now have to be made the subject of a distinct patent; so that the mere numerical increase of applications is somewhat deceptive.

The authors point out the principal changes, both in law and procedure. Under the former head they enumerate—(1) The power of compelling the granting of licenses; (2) abolition of the right of the crown to use patented inventions without compensation; (3) a patent may be assigned for any part of the United Kingdom; (4) a British patent does not lapse on the expiry of any earlier foreign patent for the same invention. The chief alterations in procedure enumerated are the preliminary examination and the reduction of the initial fees.

It might have been well, we submit, if the authors had here discussed the opinions which are now more or less loudly expressed, both as to these changes and as to the parts of the law left unchanged. As far as we are able to observe the prevalent feeling is one of disappointment. It is complained that the duration of a patent still remains the same—shorter than, *e.g.*, that of an American patent,—and that its maintenance, even for this term, is still subject to the heavy intermediate fee of £150; that the geographical extent of a patent, instead of being enlarged, as it might have been, is still further reduced by the omission of the Channel Islands; that the preliminary examination, as it does not extend to the subject-matter of an invention, does not protect the public against the re-patenting of matter contained in existing or expired patents, or such as is described in books or has been used in trade,—but that, on the contrary, it chiefly gives a field for official fussiness. It is further urged that the provision against the cessation of a British patent on the expiry of an earlier foreign patent for the same invention is no conceivable benefit to the British inventor or the British manufacturer, and is rather a sop to those aliens who take out British patents without the remotest intention of working their inventions in this country. To the majority of inventors, also, the enactment that the Crown may work a patent without compensating the patentee is useless. Hence, it is argued, the new Act is of little value, and may even be regretted, since its recent enactment will be urged as a reason for not undertaking any effective patent-law reform.

There is also a point, not indeed in the Act or in the

Rules, to which attention should be prominently drawn. In the Patent Office Journal lists of foreign patents were regularly given. Since January 1st, 1884, this most valuable feature has been omitted, to make room, it would seem, for a reprint of the lists of trade-marks, which is superfluous, considering that a Trades'-Marks Journal already exists. It is to be hoped that the Comptroller-General will take the restoration of the foreign patent-lists into his serious consideration.

On all these points the authors are silent, considering them doubtless as outside the purpose of their work. What they, however, have undertaken to do is well done. They discuss *seriatim* the subject-matter or nature of a patentable invention, the incidents of utility and novelty which must by law accompany such inventions; who may be a patentee; the title (which is the chief matter now scrutinised by the examiners); the provisional specification, the complete specification; oppositions to the grant of patents; the date, duration, and extent of a patent; amendments of specifications: extensions or prolongations, assignments, and licenses; registration of patents; the law and practice concerning infringements; revocations; offences and their penalties; international and colonial arrangements, and the Patent Office. The advice given under all these heads is, as far as possible, based upon judicial decisions, which are here quoted with references to the original reports.

In an appendix we find the statutes, rules, and forms now existing, the patent laws of foreign states and of British Colonies.

The Elements of Chemistry. By F. W. CLARKE, Chemist of the United States Geological Survey. New York: D. Appleton and Co. 1884. 369 pp. 8vo. (Appletons' Science Text Books).

THIS is a clearly written text-book, presenting the rudiments of chemistry in a simple, logical manner, and embodying the most recent phases of the science. The author had many years' experience in teaching as Professor in the University of Cincinnati before he he was called to serve the United States Geological Survey, and his name is associated with much original work and invaluable compilations, notably the "Recalculation of the Atomic Weights," published by the Smithsonian Institution. It is pleasant to note that the author has no pet theories to propound, no idiosyncracies which would prevent the student from receiving a just notion of chemical science as it is rather than as the author imagines it is. As the author himself says, he has sought to write a text-book in which the difficulties of chemical science should be encountered progressively rather than at the beginning. He has also considered the needs of those students who, while anxious to learn, are unable to secure the aid of a teacher, and who are obliged to study by themselves; for the latter especially are the foot-note references to other works on chemistry. Bearing in mind that in most schools there are two classes of students, those who study chemistry merely as a part of a general education, and those who are likely in time to take a more advanced course, the author has treated the every-day applications of chemistry with sufficient fulness for the first, and has also written with a view to introducing a second class to the subject in a scientific manner as a basis for subsequent higher study.

He has endeavoured as a rule to present experimental evidence first and theoretical discussion of the phenomena afterwards. The experiments cited are of the simplest character, the necessary apparatus and chemicals being, with few exceptions, inexpensive, and within the reach of every school. In this connection the author says: "The student who constructs his own apparatus understands its meaning much better than if he had bought a far more elegant outfit of some dealer."

The elements are treated in the order which prevailed until the classification by *valenee* caused many authors to adopt this as the basis for sequence; thus the student becomes acquainted with oxygen, hydrogen, and nitrogen at the outset, and consequently with water and air, two immeasurably important items. In works where the single idea of valency is made the dominant factor in arrangement of topics, the student is introduced first to hydrogen and then to chlorine and its compound with hydrogen, and then to the other monad non-metals, thus encountering at the outset many of the difficulties in the science. For our own part we prefer the "old-fashioned" way honoured in the text-book under review. The author has undertaken to include the rudiments of organic chemistry within the compass of a volume of 340 pages of text; 280 pages are devoted to inorganic chemistry, and sixty to the prodigious field of organic chemistry. The ten chapters in this section are entitled respectively: Preliminary Outline, Cyanogen and Carbonyl Compounds, The Methane Series, The Fatty Acids, The Olefines, Glycerin, and the Fats, The Carbohydrates, The Benzene Derivatives, The Terpenes, Camphors, Alkaloids, and Glucosides, Animal Chemistry, Fermentation. It is pleasing to see how large an amount of useful information pertaining to carbon chemistry the author has compressed into these few pages under the captions given. Those who expect elaborate discussions of isomeres, and who seek structural formulæ occupying half-pages in size, will be disappointed; yet theoretical considerations, especially the relations of the various bodies described to each other, are by no means neglected. The book concludes with a series of questions and exercises to be amplified or increased at the discretion of the teacher, and with an index. The work is well-printed in very clear type, but the illustrations are of very unequal merit; some are obviously drawn expressly for this book, but others have served an apprenticeship in many earlier works.

CORRESPONDENCE.

ABSOLUTE ETHER.

To the Editor of the Chemical News.

SIR,—In the CHEMICAL NEWS, vol. li., p. 94, there is a letter from Mr. Alexander Buchan, calling attention to certain errors of calculation in Dr. Squibb's valuable article on "Absolute Ether," published on page 67. As my name is connected with the mistakes, and several weeks would necessarily elapse before Dr. Squibb could reply himself, I beg to say that in Squibb's *Ephemeris* for November last there is a supplementary article headed "Absolute Ether: Important Correction;" and in this article the following passages occur:—

"The writer is very much indebted to Dr. A. B. Lyons, of Detroit, Michigan, for calling his attention to a gross blunder made in the calculations for specific gravities of absolute ether. . . . The blunder made consists in having wrongly divided the difference in specific gravity for 11° C. The difference for 11° C. is 0·01240. This, divided by 11, gives 0·001127+ for each 1° C., instead of 0·00127+, as there printed. That is, a unit in the fourth decimal place was in some accidental way dropped out. The erroneous difference for 1° C. having then been used for reducing the specific gravities of the various authorities to a common sp. gr. of 15° C., they were nearly all given wrong, the error being, of course, multiplied in each case.

"In now going over the figures again for this correction another blunder is found. In giving the sp. gr. at 15° C., for Allen's first sp. gr. of 0·7185 at 17·5° C., the difference for 2·5° C. was subtracted instead of being added, so that in this case there was a double blunder."

Then follows a corrected list of observations, which doubtless you will publish at an early date.

Unfortunately, Dr. Squibb's correction did not reach me in time to take advantage of it in revising the sheets for the new edition of my "Commercial Organic Analysis," With regard to the densities given in the old edition, it is scarcely necessary to say that they involve a mistake, the origin of which I am unable to trace after this lapse of time; but I may point out that, so far from their pretending to be my own determinations, in the same volume, page 6, I actually held up the density of ether as stated on page 134 as a "horrid example" of what was to be avoided.—I am, &c.,

Alfred H. Allen.

Sheffield, February 23, 1885.

PLANT VERSUS ANIMAL.

To the Editor of the Chemical News.

Sir,—Once more the vexed question has been raised of "plant versus animal" with regard to the lower forms of organism, and this time it is not from the ranks of the biologists that the battle-cry has arisen, but it is a bold chemist who has ventured into the arena. Is it not time that we should recognise the impossibility of hedging round such a question by a logical definition? Logic is an excellent servant, but a very bad master; and its iron grip has already delayed the advance of Science too long by trying to impose the "genus" and "differentia" upon it as real entities, and the definition (which is the expression of these) almost as a divine formula, instead of regarding them as mere aids, very valuable in their place, to the important work of classification. Classification itself again may readily become a task-master if we try to confer an ideal perfection upon that which in the nature of things must be imperfect. Nature does not lend herself to perfect classification, and it was the deliberate disregard of this fact which led the older botanists into the absurdities of the "bona" and "mala species"—terms of approbation or of grave reproof to Nature where she did or did not observe the all-embracing laws of formal logic! And surely to the same source we may trace the hot and often-recurring controversy among our scientific men as to whether a certain organism is an animal or a plant. As we descend the biological scale the destructive attributes of which our conceptions of "animal" and "plant," respectively, are built up disappear one by one, and we reach at last a debatable land, which we shall do wisely to leave as a neutral zone, and not pre-occupy with a "definition."—I am, &c.,

Thos. P. Blunt.

The Wyle Cop, Shrewsbury,
Feb. 18, 1885.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

Note.—All degrees of temperature are Centigrade unless otherwise expressed.

Comptes Rendus Hebdomadaires des Séances, de l'Académie des Sciences. Vol. c., No. 4, January 26, 1885.

Chemical Neutrality of Salts, and on the Use of Colouring Matters in the Determination of Acids.—M. Berthelot.—Phenol phthaleine, a reagent colourless in an acid solution, behaves almost like helianthine B (except with phenol and boric acid): it titrates sulphuric, hydrochloric, acetic, tartaric, and citric acids distinctly. It shows phosphoric acid as being bibasic. It is not affected by the alcohols, glycerin, mannite, phenol; but it occasions gradually progressive changes with boric and hydrocyanic acid. The thermic theory explains the various properties of litmus, phthaleine, and the helianthines. It indicates at the same time the possible existence of numerous other coloured reagents, intermediate and even specific, for certain acids, according to the order of the magnitude of the heat of their combinations with the bases, and the respective stability of these compounds in presence of water.

Ammoniacal Sulphate of Zinc, and the Separation of a Purely Aqueous Liquid in Two Strata.—G. André.—The author dissolved 100 grms. of crystalline zinc sulphate in liquid ammonia, well cooled, and passed into the solution a current of ammoniacal gas, avoiding any rise of temperature. In a short time striæ of an oily appearance were formed in the liquid, which became more and more opalescent, and if the current of gas was interrupted at this moment, and the liquid allowed to settle, it separated into two distinct strata. These strata could be temporarily mixed by shaking, but separated again if allowed to settle.

Formation-heat of Ammonium Sulphite and Bisulphite.—M. de Forcrand.—Not adapted for useful abstraction.

Moniteur Scientifique, Quesneville.
Vol. xv., February 1885.

On Nitrification.—R. Warington.—From the *Journal of the Chemical Society.*

Present State of Woollen Dyeing.—Amaury de Montlaur.—The author gives a full description of the principal dye-wares used for woollen goods and then discusses, more briefly, the procedures employed.

The Development of the Manufacture of Sulphuric Acid and of Soda in England.—Dr. G. Lunge.—Statistics of the British alkali manufacture from 1878 to 1883.

Starch and its Transformations under the Influence of Inorganic and Organic Acids.—F. Salomon.—From the *Journal f. Praktische Chemie.*

Phosphorus in Rural and Domestic Economy.—Dr. Wedding and Dr. Frank.—A lengthy communication made to the Agricultural Society of Berlin. The authors propose the actual trial on the large scale of the manurial value of ammonium-magnesium phosphate.

A New Announcement of the Law of Electro-chemical Decomposition.—G. Chicandard.—The author proposes the following law: "the number of equivalents of electricity necessary to decompose 1 mol. of an oxide or a salt, is equal to the valence of the metal contained in the compound in question." An "equivalent of electricity" is the quantity of electricity necessary to decompose $\frac{1}{2}$ mol. of water.

Patents for the Preparation of Colouring-Matters taken out Abroad.—A selection of German patents for improvements in dyes.

Patents Connected with the Chemical Arts obtained in France.—Titles of French chemical patents issued during November last.

Selection of Patents connected with the Chemical Arts.—Brief descriptions of French Patents issued in June and July last.

Bulletin de la Société d'Encouragement pour l'Industrie Nationale. 3rd Série. Tome xi., October, 1884.

Report presented by M. Carnot, on behalf of the Committee of Chemical Arts, on M. Manhés' Alloy of Copper and Manganese.—The author shows that the cause of the corrosion of sheet-copper employed for the sheathing of ships is the presence of cuprous oxide, which, in contact with salt water, occasions the formation of soluble salts, even when the air is excluded. In order to reduce more completely the oxygen compounds present in the copper, he introduces a small quantity of metallic manganese, which completely reduces the cuprous oxide remaining in the metal, and becomes converted into a manganese silicate in contact with the sides and the sole of the furnace. If a few thousandths of manganese remain alloyed with the copper they affect neither its malleability nor its resistance to the action of sea-water. The manganese is introduced in the form of cupro-manganese, an alloy containing 75 per cent of copper and 25 of manganese.

On the Antiseptic Properties of Carbon Disulphide.—M. Ckiandi Bey.

On Carbon Disulphide and the Use of its Aqueous Solution for the Treatment of Phylloxerised Vines.—Eug. Peligot.—These two papers are taken from the *Comptes Rendus*.

The Resin Industry in the Landes.—A. Renard.—From the *Moniteur Scientifique*.

Journal für Praktische Chemie.
New Series, Vol. xxx., Parts 6 and 7.

A Method for Determining the Density of Solids Soluble in Water.—J. L. Andreae.—These two papers make reference to the accompanying illustration.

Phosphorus and Arsenic Trifluorides.—H. Moissan.—From the *Comptes Rendus*.

Action of Iodalkylen upon Silver Fulminate.—G. Calmels.—From the *Comptes Rendus*.

Bulletin de la Société Chimique de Paris.
Vol. xliii., No. 2, January 20, 1885.

Action of Hydrogen Peroxide upon the Hydrates of the Rare Earths.—P. T. Cleve.—This paper will be inserted at some length at an early opportunity.

Action of Hydracids upon Selenio-Urea in presence of Oxygen.—A. Verneuil.—Under these circumstances the hydracids give rise to products at once oxygenated and condensed, the analogues of which are not known among the derivatives of urea and sulphurea.

On the Composition and the Qualities of Coal with Regard to the nature of the Plants from which it is formed.—M. Ad. Carnot.—Already noticed.

The Origin and the Distribution of Phosphorus in Coal and Cannel.—M. Ad. Carnot.

The Absorption and Determination of Small Quantities of Hydrogen Sulphide in Gaseous Mixtures.—M. Osmond.—The author assumes that a determination of sulphur has to be made by Rollet's method. This process, which is very general and very exact, consists in passing at a cherry-red heat over the substance in question a mixture of hydrogen and carbonic acid. The sulphur, unless volatile as such below redness, is entirely converted into hydrogen sulphide, which is absorbed in an acidulated solution of silver nitrate. In place of treating the precipitated silver sulphide according to the ordinary rules, the author passes the gaseous mixture containing the hydrogen sulphide into a series of bottles arranged in such a manner that the bottom of each is connected with the neck of the following one. We pour into each bulb a known quantity of a standard solution of silver nitrate: the apparatus is then connected with the tube containing the matter under examination, and the operation is commenced. The hydrogen sulphide, as it is evolved, is absorbed in the first bottle as long as this contains the least trace of silver in solution. When all the silver is precipitated the sulphuretted hydrogen passes into the second bottle, and no further. If the standard of the silver solution and the weight of the sample taken for analysis are so arranged that each bottle corresponds to a given percentage of sulphur, *e.g.*, 0·01 per cent, it is sufficient to count, when the process is completed, the number of bottles containing a precipitate. Filtration, ingition, cupellation, and weighing are thus avoided. The degree of approximation may be fixed beforehand by the quantity of silver contained in each bottle. It may be enhanced by adding to the last bottle, which contains silver sulphide, a drop of hydrochloric acid, and determining the precipitate of silver chloride formed. This process is especially applicable to substances containing but little sulphur. Salts of lead or copper cannot be substituted for silver nitrate, as they do not absorb the hydrogen sulphide instantaneously, and the precipitation consequently takes place in several bottles at once.

MEETINGS FOR THE WEEK

MONDAY, March 2nd.—Medical, 8. (Anniversary).
— London Institution, 5.
— Royal Medical and Chirurgical, 8. (Anniversary).
— Society of Arts, 8. (Cantor Lectures.) "The Chemistry of Pigments," by J. M. Thomson, F.R.S.E., F.C.S.
— Royal Institution, 5. General Monthly Meeting.
— Society of Chemical Industry, "Some Experiments upon that part of Mr. F. B. Rawes's Patent, for the 'Recovery of Sulphur, &c.,' which depends upon the Action of Carbon Dioxide upon Soda-Waste suspended in a Liquid," by W. J. Kemp. "The Treatment of certain Phosphatic Minerals," by W. J. Williams.
TUESDAY, 3rd.—Royal Institution, 3. "Digestion and Nutrition," by Prof. Gamgee.
— Institution of Civil Engineers, 8.
— Pathological, 8.30.
WEDNESDAY, 4th.—Society of Arts, 8. "The Evolution of Machines," by Prof. H. S. Hele Shaw.
— Pharmaceutical, 8.
THURSDAY, 5th.—London Institution, 5 and 7.
— Royal, 4.30.
— Royal Institution, 3. "The New Chemistry," by Prof. Dewar.
— Chemical, 8.
FRIDAY, 6th.—Royal Institution, 8. "German Discoveries at Pergamus," Mr. C. T. Newton, at 9.
— Society of Arts, 8. "The Trade between India and the East Coast of Africa," by Frederick Holmwood.
— Geologists' Association, 8.
SATURDAY, 7th.—Royal Institution, 3. "Richard Wagner," by Mr. C. Armbruster.

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THE CHEMICAL NEWS.

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SODIUM ALUMINATE.

By F. MAXWELL LYTE, F.I.C., F.C.S.

Having occasion to use sodium aluminate in the course of some experiments I was led to consult books on the subject, and was struck by a marvellous discrepancy between the formula for that substance as given by Roscoe and that given by Groves in his late edition of "Miller." Roscoe gives $Na_2Al_2O_4 = 165$: Groves gives $Na_6Al_2O_6 = 289$. 100 parts of sodium aluminate contain according to Roscoe only 27·87 parts of sodium; while according to the formula of Groves it contains no less than 57·75 per cent. There is, besides, a similar disparity in the aluminium. Allowing, then, that one or the other is correct, the enormous difference between the two allows one to decide which is right by an experiment even in a rough way on the impure commercial salt. I determined, then, to make use of the following reaction to decide the question. According to the formula of Roscoe the reaction with aluminium sulphate should be as follows:—

$$Al_2(SO_4)_3 18H_2O + 3(Na_2Al_2O_4) = 3(Na_2SO_4) + 4(Al_2(HO)_6) + 6H_2O;$$

and according to that of Groves—

$$Al_2(SO_4)_3 18H_2O + Na_6Al_2O_6 = 3(Na_2SO_4) + 2(Al_2(HO)_6) + 12H_2O.$$

One atom of aluminium sulphate takes, then, three atoms of aluminate in the first case, and but one in the second; or I might have used the reaction between sodium aluminate and ammonium chloride, estimating the amount of sodium in the aluminate by that of the ammonia set free.

Having procured some aluminium sulphate as well as some of the sodium aluminate of commerce, I estimated the real anhydrous sulphate in the first-named salt, deducing it from the amount of carbonic anhydride evolved by a given weight in a carbonic acid apparatus, and I found it to be 35 per cent. It did not contain any free acid. I then dissolved 100 grms. of each salt in water, filtering and washing as usual, and making up the volume of the liquid in each case to 500 c.c. The sulphate was entirely soluble, but the aluminate left about one-fifth of its weight of undecomposed bauxite on the filter. This, and the fact that an ash of probably not over 90 per cent carbonate had been used in making it, led me to conclude that I might have to do with an aluminate of about 70 per cent. Each c.c., then, of both solutions represented 0·2 grm. of the respective impure salts.

On saturating a sample of one of these solutions with the other, it was found that to produce perfect neutrality, and completely throw down all the alumina, 38 c.c. of aluminate solution were required for 50 c.c. of sulphate.

Now the atomic weight of pure aluminium sulphate, neglecting the water of crystallisation, is 343, and that of sodium aluminate according to Roscoe is 165. The 50 c.c., then, of sulphate solution being made from a 35 per cent salt, contained 3·5 grms. of the pure anhydrous salt, and the 38 c.c. of the aluminate solution from a 70 per cent salt contained 5·32 grms. of pure sodium aluminate. These proportions, then, being found to saturate one another, the theoretical quantity according to Roscoe would be 5·057, and allowing for the uncertainty as to the percentage of the aluminate, show a sufficient correspondence with the theory to prove that Roscoe's formula is right. If, however, the aluminate solution be made too concentrated, by dissolving it, for instance, in four parts, or rather less, of water it is liable to decomposition, with formation of sodium hydrate and of aluminium hydroxide, thus approaching Groves's formula, and it cannot be safely kept in solution at a higher degree of concentration than sp. gr. 1·140.

The aluminate, also, made by fusing cryolite with just the requisite amount of calcium hydroxide, has probably the composition of Groves's salt.

NOTE ON CAMPHOR MOTIONS.

By P. CASAMAJOR.

On the 4th of October, 1877, I read a paper "On the Motions of Camphor on the Surface of Water,"* before the American Chemical Society, in which I described experiments, which had led me to the conclusion that these motions were due to electricity.

The extraordinary motions which give an appearance of life to pieces of camphor, swimming on the surface of water, are not to be seen at all times. Very often camphor will remain motionless, while at other times the pieces gyrate with great animation. One of the earliest observers of these singular motions, Romien (1748), came to the conclusion that they were due to electricity, while subsequent investigators, among whom may be counted the great Volta, have generally decided that there is no connection between electricity and the motion of camphor on water.

I was led to believe that camphor motions were due to electricity by the results of experiments, of which I will give a brief account.

When pieces of camphor are thrown on water, they may remain torpid or they may gyrate with every appearance of life. In the latter case the motions may be instantly arrested by dipping a finger in the water on which the camphor moves. If we have pieces of camphor lying quietly on water, they may be made to move by dipping into the water a rod of either glass, sealing-wax, or vulcanite, electrified by friction. After every immersion the glass is to be dried by wiping with a dry cloth or a piece of bibulous paper; and, before every immersion, the rod is electrified by rubbing with a piece of silk or flannel. After one or more immersions of the electrified rod, the camphor motions invariably start, and by a few additional immersions they increase in intensity. The fact that these motions could be started by means of an electrified rod was a new one. Those who had decided that camphor motions were not due to electricity were not acquainted with it, and I was led to believe by this fact, and by others which I gave at the time, that camphor motions were electrical phenomena. There was, however, something unsatisfactory in this method of applying electricity to the water on which pieces of camphor floated, but, at that time, no other method occurred to me. Afterwards the whole subject slipped from my mind, but, quite recently, the following experiment has suggested itself, which seems to show that camphor motions are not due to the state of electrical tension of the liquid on which pieces of camphor float.

The experiment was performed in a glass dish about two inches deep, and of five inches diameter. This was filled with water up to within an inch of the top. The bottom of the dish and the sides, up to within an inch of the top, were covered with tin-foil. A metallic wire dipped in the water of the dish, with one end out of the water, but having no connection with the outside lining of tin-foil.

This glass dish was the equivalent of a Leyden jar, which could be charged with electricity from the plate of an electrophorus by touching the wire dipping into the water with this plate, laying a finger at the same time on the outside armature.

A few pieces of camphor were placed upon the water

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* Chemical News, vol. xxxvi., p. 191.

in the dish, and these were reduced to immobility by dipping a finger in the water. After this the water in the dish was charged with electricity by repeatedly placing the plate of an electrophorus in contact with the wire dipping in the water, while the outside armature was touched with a finger.

There was no effect produced on the pieces of camphor floating on the water of the dish. These remained motionless, not exhibiting the slightest tremor. There could be no doubt that the water surface was in a greater state of electrical tension in this experiment than when the water is electrified by dipping an excited rod in it, for, by placing one hand on the outside armature of the dish, and slowly approaching the water surface with a finger of the other hand, a perceptible spark was obtained.

There seems to be a discrepancy between the results to be obtained in these two classes of experiments.

By dipping an electrified rod successively in water the camphor motions always take place, while, when we electrify by applying the plate of an electrophorus to the water in the dish, as described, not the least tremor can be perceived. As these results were obtained over and over again, there cannot be any doubt as to the difference of the effects in the two modes of operating.

The conclusion that may be drawn is that camphor motions are not caused by electricity. In the case of an electrified rod, dipped successively in water, I am inclined to the opinion that electricity acts indirectly by removing physical impurities from the surface of the water, as shown by the following experiment.

Take a glass of water, and on its surface place a few pieces of camphor. If these are inclined to move, they may be stopped by dipping a finger in the water. Then blow a cloud of lycopodium powder over the surface of the water, so as to cover this surface uniformly with the powder. Lycopodium in no way interferes with camphor motions, which may be of the liveliest on water covered with the powder. If now an electrified rod is dipped repeatedly in the water, wiping it dry after every immersion, and rubbing it with a piece of flannel before dipping in the water again, the result will be that the pieces of camphor will move as if gifted with life. It will be noticed at the same time that the surface of the water will be almost entirely free from lycopodium, as the powder has been gradually removed by each successive immersion of the electrified rod, which attracts lycopodium like all other light bodies. If now we suppose that films of oily matter are removed in the same way by an electrified rod, we may conceive electricity can act indirectly in removing impurities from the surface of the water.

There would remain to explain why films of oily matter or other impurities act as a check on camphor motions, while a physically clean water surface is a favourable condition in producing these motions. Towards the solution of these questions I will venture the following explanation, which may serve as the base of further researches.

It is a well ascertained fact relating to camphor motions that when these motions take place the camphor dissolves in water more quickly than when the camphor is at rest. I think that a connection exists between camphor motions and the three following facts:—

1st, that camphor dissolves in water quite easily at times; 2nd, that its density allows it to float on water; and 3rd, that the solution has a density slightly different from that of water. I am not prepared at present to develop these ideas, which would require further experiments to establish.

I will confine myself to the well ascertained fact that a piece of camphor wears away much faster when in motion than when at rest. This being established, it appears more than probable that if a piece of camphor is perfectly free from oily matter it will dissolve in water more readily than if protected by a greasy film. The slightest film of this nature, in contact with camphor, becomes a saturated oily solution of camphor, and if any excess exists, over what will cover the camphor, the greasy film will extend over the surface of the water.

When things are in this condition, if an electrified rod rod is dipped several times in the water, every immersion will remove a portion of oily film from the surface, until finally the film on each piece of camphor becomes so thin that the water reaches the pieces of camphor, and these immediately become gifted with motion.

CONTINUOUS ETHERIFICATION.

By L. M. NORTON and C. O. PRESCOTT.

Since the examination of the process of continuous etherification by Williamson,* and the explanation of it in his classical research, our knowledge of its possible applications has made no material progress. The formation of ethers by the action of sulphuric acid upon alcohols has found practical application only in the manufacture of ethyl ether in the manner proposed by Boullay† before the course of the reaction was understood, and in the manufacture of methyl ether,‡ which is now used extensively for cooling purposes. We have re-examined the formation of ethyl ether by this process in order to fix more carefully the limits of temperature within which the reaction can be effected, and also the temperature at which etherification is most complete, and we have also investigated the behaviour of propyl, isobutyl, and isoamyl alcohols when subjected to the process of etherification. We have examined also the formation of mixed ethers by this process.

Ethyl Alcohol.

The apparatus used in all the experiments described below was essentially that originated by Boullay, and afterward used by Williamson. It consists of a 2-litre flask, with a wide mouth closed by a cork through which passes a thermometer, a drop-funnel, and a delivery tube leading to a condenser cooled continually with ice-water.

In the first series of experiments 200 grms. of commercial 90 per cent alcohol were subjected to etherification in each experiment: 20 grms. of alcohol were mixed with 36 grms. of ordinary strong sulphuric acid, placed in the flask, which was then heated to the desired temperature in an oil-bath, and the mixture was maintained at the desired temperature while the remaining alcohol was slowly added through the drop-funnel. It is evident that if the distillate was subjected to fractional condensation, and the undecomposed alcohol returned to the generating flask and only the ether collected, in sufficient time the alcohol would be changed to ether, even at a temperature far too low for advantageous etherification. As we desired to examine the amount of alcohol changed to ether at different temperatures, we allowed the ether and undecomposed alcohol to distil together from the generating flask, and subsequently subjected the distillate to fractionation. The distillates from temperatures below 160° were free from sulphurous anhydride. They were treated with solid caustic potash to remove any traces of sulphuric acid, and then distilled from quick-lime. After three fractionations, the portions boiling between 35° and 45° were weighed. In these experiments 163 grms. of pure ethyl alcohol were available for etherification.

Temperature of Formation.	Weight of Ether obtained.	Per cent of Theoretical Yield of Ether.
120° to 125°	12 grms.	7·35 per cent.
125 130	27 ,,	16·55 ,,
130 135	45 ,,	27·58 ,,
135 140	45 ,,	27·58 ,,
140 145	47 ,,	28·81 ,,
145 150	47 ,,	28·81 ,,

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* *Ann. d. Chem.*, 77, 37, and 81, 73.
† *Journ. Pharm.*, 1, 96.
‡ Tellier, *Arch. Phar.*, 16, 57.

A second series of experiments was now made, and the distillates were fractionated with the utmost care. In these experiments 150 grms. of 90 per cent alcohol were used, and 118 grms. of ethyl alcohol were available for etherification. The specific gravity of the ether obtained was 0·744 at 0° compared with water at the same temperature. This specific gravity would indicate the presence of a minute quantity of alcohol in the ether.

Temperature of Formation.		Weight of Ether obtained.	Per cent of Theoretical Yield of Ether.
115° to	120°	5 grms.	4·2 per cent.
120	125	10 ,,	8·4 ,,
125	130	20 ,,	16·8 ,,
130	135	33 ,,	27·7 ,,
135	140	43 ,,	36·1 ,,
140	145	52 ,,	43·6 ,,
145	150	47 ,,	39·5 ,,
150	155	49 ,,	41·0 ,,
155	160	48 ,,	40·3 ,,
160	165	? ,,	

These results would indicate that the action of alcohol upon ethyl-sulphuric acid begins at a temperature much lower than has been supposed, and rises in rapidity and completeness until the temperature of 145° is reached, where the maximum yield of ether is obtained. Above 150° the yield begins to lessen, and doubtless the formation of ethylene begins, but the yield does not diminish greatly until 160° is reached. At 160° the formation of sulphurous anhydride begins, and numerous gaseous products are evolved, and the sulphuric acid is soon destroyed, as has been observed by others.[*] Ether continues to be formed above 160° in small quantities, and, according to Mitscherlich,[†] is even found among products formed at 200° and above that temperature.

Propyl Alcohol.

We were unable to find any evidence that this alcohol was ever subjected to the process of continuous etherification. We took 50 grms. of propyl alcohol for our experiment: 15 grms. were mixed with 20 grms. of sulphuric acid, the mixture heated at 135°, and the remaining alcohol added in the usual way. A colourless distillate was obtained, at the same time there was a slight evolution of sulphurous anhydride and a slight deposition of tar in the generating flask. The distillate was treated with solid caustic potash, then distilled from lime, and was found to boil between 80° and 90°. It was next washed with water, distilled again from lime, and then allowed to stand with sodium until all action ceased. Its boiling-point was then between 82° and 84°; it possessed a strong ethereal odour, and agreed in all respects with the propyl ether described by Chancel[‡] and Linneman.[§] The yield is very good, and this method will prove the most convenient for the preparation of propyl ether.

Isobutyl Alcohol.

It is well known[||] that at a high temperature sulphuric acid withdraws water from isobutyl alcohol and produces isobutylene. We have subjected isobutyl alcohol to the ordinary process of continuous etherification at 120°, and also at 135°. In both cases sulphurous anhydride was freely evolved, and tar remained in the generator.

A yellowish distillate was obtained, which upon purification and fractionation proved to consist of undecomposed isobutyl alcohol. We were unable to obtain any appreciable quantity of isobutyl ether.

Isoamyl Alcohol.

We next investigated the behaviour of isoamyl alcohol under the ordinary conditions of continuous etherification. At temperatures very little above 100° a violent action begins, and sulphurous anhydride is freely evolved. Before the temperature of 140° can be reached the sulphuric acid is destroyed, and only tar remains in the generator. As isoamyl ether boils at 176° it is evident that it cannot be produced by this method. Below 140° a distillate was obtained, which proved to contain undecomposed isoamyl alcohol and hydrocarbons of the C_nH_{2n} series. We were unable to confirm the statement of Balard[*] that small quantities of isoamyl ether are formed by the action of sulphuric acid upon isoamyl alcohol.

Methyl and Ethyl Alcohols.

The authority for the statement that mixed ethers can be obtained by the process of continuous etherification rests upon two experiments of Williamson.[†] It seemed desirable to test the applicability of this process to the formation of mixed ethers anew, especially as Guthrie[‡] was unable to repeat one of Williamson's experiments. We chose for an experiment a mixture of methyl and ethyl alcohols, containing 1 mol. of CH_3OH to 1 mol. of C_2H_5OH. This mixture was treated in the usual manner at 140°, and the utmost care observed in condensing the products. A colourless distillate, free from sulphurous anhydride, was obtained, and at the same time a gas, which we were unable to condense, escaped from the apparatus. This gas possessed a strong ethereal odour, and was doubtless methyl ether, which boils at $-23°$. The distillate resolved itself upon fractionation into three portions, one boiling from 10° to 15°, the second from 30° to 40°, and a third portion consisting of undecomposed alcohols. We obtained from the portion boiling lowest a considerable quantity of a liquid boiling between 10° and 13°, possessing a strong ethereal odour, and corresponding in every respect with the methyl-ethyl ether prepared by Williamson[§] from sodium alcoholate and methyl iodide, and also by Würtz,[||] by the action of a mixture of methyl iodide and ethyl iodide upon silver oxide. The portion of the distillate boiling between 30° and 40° consisted mainly of ethyl ether. The yield of the mixed ether was very good. The three possible ethers appear to be formed simultaneously, but the mixed ether is formed in much the largest proportion.

Ethyl and Propyl Alcohols.

A mixture of equivalent parts of these alcohols was next treated in the usual manner. A colourless liquid was obtained, which resolved itself upon fractionation into ethyl ether, a mixture of ethyl and propyl alcohols, and a portion boiling between 60° and 80°. The portion boiling between 60° and 80° was washed with water, distilled from quick-lime, and finally treated with an excess of sodium to remove any alcohols present, and rectified. The liquid then boiled between 60° and 68°, and possessed an ethereal odour, and gave the following results upon analysis:—0·2286 grm. of substance furnished 0·5620 grm. of CO_2 and 0·2827 grm. of H_2O.

	Theory for $C_3H_7OC_2H_5$.	Found.
C	68·17	67·04
H	13·64	13·74

The analysis leaves no doubt that the substance is the ethyl-propyl ether which was first prepared by Chancel[¶] by the action of ethyl iodide upon propyl alcohol and caustic potash.

Ethyl and Isobutyl Alcohols.

Equivalent parts of these alcohols were subjected to the usual treatment. Sulphurous anhydride was freely evolved, and a yellow distillate with a very disagreeable

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[*] Gmelin, *Handbuch*, 4, 552.
[†] *Ann. Ch. Phys.*, 3, 7, 12.
[‡] *Ann. d. Chem.*, 151, 304.
[§] Linneman, *Ibid.*, 161, 37.
[||] Lermontoff, *Ibid.*, 196, 117, *et al.*

[*] *Ann. d. Chem.*, 3, 12, 294.
[†] *Ibid.*, 81, 77.
[‡] *Ibid.*, 105, 37.
[§] *Ibid.*, 81, 77.
[||] *Ibid.*, 3, 46, 222.
[¶] *Zeit. f. Chem.*, 1869, 367.

odour obtained. The distillate consisted almost entirely of undecomposed alcohols, and no ether could be obtained from it. The mixture behaved exactly as did the isobutyl alcohol alone.

Methyl and Isoamyl Alcohols.

Methyl-isoamyl ether was prepared by Williamson* by the continuous etherification of a mixture of these alcohols. We repeated his experiments, following his directions with the utmost exactness. Sulphurous anhydride was evolved in large quantities. In the distillate obtained we found undecomposed alcohols and products similar to those obtained from isoamyl alcohol alone under like conditions, but were unable to detect the presence of methyl-isoamyl ether. We made repeated attempts at 135° and 140°, but the distillate in every case consisted almost entirely of the alcohols which had distilled undecomposed as soon as the sulphuric acid had been all reduced. An attempt by Guthrie† to obtain ethyl-isoamyl ether by continuous etherification, in the manner described by Williamson, gave similar results, and Guthrie was unable to obtain the ether by this method. As our experiments show that etherification does not take place to any extent, certainly in the case of ethyl alcohol below 105°, and as isoamyl alcohol decomposed sulphuric acid with the evolution of sulphurous anhydride at that temperature, it is evident that the ordinary process of continuous etherification can only be applied to the formation of the simple and mixed ethers from the simplest alcohols, and it is not probable that it can be used satisfactorily for the etherification of alcohols containing more than three atoms of carbon.—*American Chemical Journal.*

HYDROCHLORATE OF COCAINE,

OR MURIATE OF COCAINE.‡

(Concluded from p. 100).

Since the writer's last note on this subject the original paper of Dr. Carl Koller, of Vienna, the discoverer of the anæsthetic effects of cocaine salts, has been published. It is a very important paper, and a translation of it may be found in the London *Lancet* for December 6, 1884, page 990. The paper was read at the meeting of the Vienna Royal Imperial Society of Physicians on October 17th, 1884. Its English title is "On the Use of Cocaine for Producing Anæsthesia on the Eye." "Translated and Revised by J. N. Bloom, B.A., M.D." This paper sets at rest several important points which should be noted. Dr. Koller says his first announcement of his discovery was to the Convention of German Oculists which met at Heidelberg on the 15th and 16th of September.

He says it is a well known fact since 1862, when it was announced by Prof. Schroff, that cocaine anæsthetised the mucous membrane of the tongue. And that it was also known that, when taken internally, it narrows the peripheral arteries, and farther, that the pupil was dilated both by its local application and its internal use. Dr. von Anrep in 1880, published researches upon cocaine, at the end of which it was hinted that the local anæsthetic action of cocaine might in the future become of considerable importance. But it was not until his, Dr. Koller's, investigations and experiments, first on animals and then on man, that its practical applicability to general use as a local anæsthetic was known, and of this he was the discoverer, and he was led to the discovery by the known effects upon the tongue. He states that in his experiments he used the "muriate of cocaine" in aqueous solution, and that when a few drops of this was put into an animal's eye the first effect was that of a weak irritant. To this statement he has a footnote to the effect that "A solution of cocaine in water, up to 5 per cent, can be made without the addition of an acid. The solution is always cloudy. The addition of an acid is to be avoided, as even a very small quantity of an acid causes a very strong burning sensation. When filtered the solution becomes as clear as distilled water." This note was either too loosely written or badly translated. The alkaloid cocaine is scarcely at all soluble in water. Authorities say 1 part in 704 of water, and this is probably correct. The author meant to say that the "muriate of cocaine" as he calls it in the text of his paper, meaning the hydrochlorate, was soluble to the strength of 5 per cent, but always gave a cloudy solution which was cleared by the addition of an acid, but that the addition of an acid was objectionable. In this statement he is in error, as any well made muriate, or hydrochlorate of cocaine, is perfectly soluble in less than its weight of water, and makes a clear solution which is neutral, and not acid.

From experiments on animals he found that the anæsthesia was very superficial, and only complete for the cornea and conjunctiva. From these he proceeded to experiments upon himself and a few colleagues, and finally upon patients, The sequence of the symptoms he gives as follows:—"When a few drops of a two per cent solution are introduced into the conjunctival sac, or, better still, if they are allowed to run over the cornea,—together with an increased secretion of tears, a slight burning sensation is felt, which disappears after an interval of from thirty seconds to a minute, to give way to an obscure feeling of dryness. To the observer an eye thus treated has a peculiar rigid expression, very like that which I noticed as remarkable on the animals upon which I experimented. This expression arises from a decided widening of the palpebral fissure, the explanation of which I shall give later. If now the head of a pin is brought in contact with the cornea we note the absence not only of the pain usually associated, but we absolutely do not feel the contact, and all reflexes are absent. The same holds good for the conjunctiva, which loses its sensibility to heat and cold. Without any inconvenient sensation, or the slightest reflex movement on the part of the patient thus treated, we can grasp the conjunctiva of the bulb with a toothed forceps, or we can pit the cornea by pressure. In this connection the only thing to be observed is that the appearance of objects becomes indistinct, which naturally is caused by the changed curvature of the cornea. This complete anæsthesia lasts from seven to ten minutes, to give way to the normal condition after a considerable period of subnormal sensibility." He then goes on to describe the mydriatic effects, and, finally, to its therapeutic and surgical application, uses, and effects. He finds that its use in diseases of the eye has no influence, beneficial or otherwise, on the course of disease, but simply relieves the pain temporarily, or during the repetition of the application; but the pain, intolerance of light, &c., seem to have been lessened, not abolished.

The agent, however, was too dear for continued trials in these cases, and all the trials seem to have been made with a 2 per cent solution, and that solution made from a salt which does not seem to have been very good, although he suspected no deficiency in quality,

In the surgical applications, however, he used a 5 per cent solution, and commencing half an hour before the operation, instilled two drops every five minutes, the patient lying on his back without a pillow; and even by this method the deeper tissues of the eye were not insensible, though the iris was cut without pain.

In reviewing these statements of Dr. Koller, it will be observed that they are moderate in tone and character, and not enthusiastic, and that they have been in the main fully confirmed by many observers.

It has been said that the smarting or burning from the first instillation was more severe and more prolonged than

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* *Ann. d. Chem.*, 81, 77.

† *Ibid.*, 105, 37.

‡ From "An Ephemeris of Materia Medica, Pharmacy, Therapeutics, and Collateral Information." By Edward R. Squibb, M.D., Edward H. Squibb, S.B., M D., and Charles F. Squibb, A.B.

it should be from his history; but it must be remembered that so bitter and powerful a salt could not but be primarily irritant, and that a 4 per cent solution, as now commonly used, must be twice as irritating as one of 2 per cent. It seems rational and probable that a single drop of 4 per cent solution at first, would reduce this smarting to a minimum, and admit of the larger dose of two drops to be used in the drier stage, when it would be less diluted by tears and when less of it would be washed away.

From the accounts of operators here, it would seem that two drops of a 5 per cent solution every five minutes, for half an hour, is wasteful, both of the agent and of time, unless the agent was defective in quality. Five drops of a 4 per cent solution in two instillations, ten minutes apart, seems to be a sufficient quantity, and fifteen to twenty minutes a sufficient time. Some operators give the history of a much more copious use of the solution, and this suggests the probability of great waste. The greater or less lachrymation in different cases has doubtless an important bearing both upon the quantity required and the time, by the greater or less dilution and washing away of the agent.

In applying the solution to other mucous membranes than those of the eye, a camel's hair pencil has generally been used, but under the very best management, and upon surfaces made as dry as possible, the pencil leaves but a very small quantity upon the surface, and it is not to be expected that complete anæsthesia is easily attainable in this way, however frequent the applications, and a profuse use of the agent does no good, since it immediately runs off the surface. Neither is it of any use to apply it to surfaces coated with secretions, no matter how thin the coating, if they are of the glairy kind, since efficient contact with the surfaces is then impossible, and the waste is as complete as an application to the skin covered by epidermis. So, on its application to painful ulcers, burns, &c., care must always be taken to obtain contact of the solution by having the surfaces perfectly clean. A blistered surface, if covered with the natural exudation, is almost or quite beyond the reach of the solution in proportion as the exudation is thin enough in consistence to mix with the solution when applied. The model condition for effective use is the mucous membrane of the eye, and upon any surface in that clean condition it will be as certainly effective. In applying it to denuded surfaces and to mucous membranes which will admit it, the best method is to have some light covering of the desired shape and size, that will hold the solution. A thin filtering paper will be moistened over an area of fully a square inch by a single drop, or half a minim of the solution, and under favourable circumstances that will superficially benumb an equal area of mucous membrane. Any one can convince himself of this fact by placing such a piece of paper on his tongue, if the organ be rinsed off clean before the paper is laid on. Such a paper when touched occasionally with a camel's-hair pencil charged with solution will have its efficiency strengthened, and upon the tongue, for example, any effect possible to the agent is obtainable in that way. But paper is not a convenient tissue for such application. Fine thin cotton or linen fabric is much better, and nothing can be better than well-worn fine handkerchief material. This is sufficiently absorbent to hold the dose, and thin enough to avoid waste and to be closely applicable to irregular surfaces. When touched in situ, for re-supply, the brush should be applied to the upper edge of the tissue, so as to run down through it before draining off, and the smallest possible quantity should be applied at a time if waste by running off be avoided. Much solution is wasted by the use of camel's-hair pencils many sizes too large. Indeed, it is hardly possible to get a brush too small to convey this solution economically, unless large surfaces are to be coated. In the use of a brush for applying the solution it should never be dipped into the phial of solution, because it carries back secretions and excretions which rapidly spoil the remaining solution, and it is thus wasted. The proper way is to drop out the quantity to be used on the bottom of a tumbler or wine glass, and dip the brush in this until it is all used, never putting any back into the phial. In this way any desired quantity may be used and none be spoiled or wasted. If any one will try the effect of a single drop of 4 per cent solution put directly upon his tongue without rinsing, and then, half an hour later, rinse the tongue clean and apply the same quantity upon a piece of thin bibulous paper half an inch in diameter, he will be convinced that many failures are due to faulty application, and may see that one drop well applied may be as effective as the nature of the agent will admit of, and quite as effective as ten drops badly applied. From reading the published accounts of the application of the solution, it seems highly probable that more of it is wasted than is really utilised, and if this waste could be stopped without increasing the number of failures, the price of the chemical would soon come down.

Little has been written upon the mode of action of cocaine salts as local anæsthetics; or, rather, the writer has seen no attempt to explain how coca in substance should be a nervous stimulant, and yet its alkaloid be a most powerful nervous sedative. The two effects cannot possibly be antagonistic, for that is irrational, neither can the effects be due to quantity. Some other rational explanation will doubtless be reached, and the writer offers the hypothesis that the local effect may be measurably a mechanical one, and thus be independent of the effects when it is taken internally. Any agent that would contract the supply vessels of the terminal bulbs of the sensitive nerves, and press out the blood from them, would to the same extent lessen the sensibility of the part, and if the capillaries were emptied entirely by such contraction, sensation would be abolished as completely as the galvanic current is abolished when the liquid is drawn off from the plates. The application of cold abolishes sensation in this way, and is a local anæsthetic of the same character as cocaine salts, and the benumbing is of the same kind in its observable degrees. Heat also has a similar action when just short of that degree which coagulates the albumen of the bulbs and the circulating fluids. Carbolic acid is also a very effective local anæsthetic by something of the same kind of action, of contracting the capillary vessels, and thus diminishing the supply of the excitant fluid necessary to the function of sensation. But all these agents, when their action is carried to the degree of complete anæsthesia, are proportionately destructive of tissue, and either kill the parts or cause destructive inflammation. All cause blanching of the tissues by pressing out the colouring liquid—namely, the red blood; and tissues when thoroughly benumbed by cold or heat or carbolic acid, are found comparatively bloodless when incised. An injury to a very cold hand or foot is not painful, neither does it bleed much, but, as it is warmed, the bleeding and pain come on together. It has been noticed by several observers that red mucous membranes, when anæsthetised by salts of cocaine, are white, and when cut into very superficially,—that is, when the cut is not deeper than the anæsthesia,—there is but little bleeding. This, if true, is precisely the condition in anæsthesia by cold, and the condition in both cases may be due to the same cause, namely, contraction of capillaries, whereby the circulation is diminished or practically suspended. Then, if the effect of cold in producing anæsthesia be a mechanical effect, the similar effect of cocaine, if produced in a similar way, is probably also mechanical. This, in a profound sense, is of course no explanation at all, since it does not touch the reason why cocaine should, or does, contract the capillary vessels, and thus deprive the function of sensation of its exciting cause and necessary condition; but yet such explanation goes far enough to show how the same agent may rationally be a nervous stimulant when given internally, and yet be a powerful nervous sedative when locally applied. Indeed, the explanation given of the mode of action is supported by the observations of the early investigators of the physiological effects when internally administered, since they showed that one prominent effect was to contract the peripheral arteries.

If the explanation be true, there is no difficulty in comprehending why the local anæsthesia is a condition of degrees, and can hardly be complete in tissues supplied with vessels of considerable size, and that the anæsthesia of tissues below the surface must depend for degrees upon the rate and amount of absorption of the agent, since it cannot be conveyed from the surface to the deeper parts by vessels which are closed or contracted by it so as to abolish or reduce their carrying capacity.

The explanation also serves to show why it is without effect when applied to the skin, since the epidermis there prevents mechanical contact with the capillaries. But if the skin was well soaked with water so as to soften the epidermis and bring it into a condition similar to that of the epithelium, then the agent should at least have some effect. Or in combination with, or solution in, some such liquid as oleic acid, which can get through the epidermis, or be absorbed, it should be somewhat effective.

The position taken by the writer of having abandoned coca as a therapeutic agent on account of the poor quality of the drug as accessible in the markets, has been publicly criticised when it was found that that same coca, thus condemned, really yields a larger proportion of cocaine, and has been the source from which most of the alkaloid has been obtained.

This is apparently a fair criticism, and the position perhaps requires a word of defence. Coca as a therapeutic agent is a nervous stimulant, yielding effects identical with those of tea and coffee, while the effects of the alkaloid cocaine are those of a local anæsthetic—the two effects being as dissimilar as are those of tea from those of benumbing cold. The nervous stimulation derived from tea and coffee appear to be something distinct from, or something superadded to, the effects of their common principle caffeine. That is, the commonest Congo teas which sell at 20 to 25 cents per pound, contain over 70 per cent of the amount of caffeine which the very best teas, costing 80 to 85 cents, contain, yet of course they are very far from being as good teas when applied to the usual purpose of nervous stimulation. The Congo teas would be, of course, far the cheapest, and therefore the best material for making caffeine from, and as a matter of fact they are so used, but they are not used when good teas or fine teas are wanted or appreciated, as nervous stimulants and restoratives.

Exactly the same conditions obtain in regard to coca. The nervous stimulant effect is something that appears to be superadded to the cocaine present, and the analogy with tea makes it easy to comprehend why good fresh coca may not contain more than 20 to 30 per cent of cocaine more than the poor, stale, brown leaves do, and yet be 50 to 70 per cent better as a nervous stimulant for therapeutic uses.

It is quite true that while some lots of the brown leaves contain scarcely any cocaine at all, others, not very dissimilar in appearance and physical properties, yield perhaps 80 or even 90 per cent of what the best fresh green leaves do, thus rendering an assay necessary to discriminate between them—it is also equally true, as far as the writer's experience goes, that the brown leaves never yield as much cocaine as the fresh green leaves do, though cheaper, and therefore better as a source from which to extract the alkaloid, and are probably never as good—even in proportion to the alkaloid contained in them, as the fresh green leaves are, for therapeutic use. Therefore, the fresh green leaves, only, should be used for making the fluid extract, and should be used without heat, and when they cannot be had, the fluid extract should be abandoned, leaving the brown leaves as proper only for the manufacture of cocaine. And if nothing but low grade Congo teas could be had in the market the fluid extract should not be made from them, but should be abandoned, although these teas contain a very large proportion of caffeine.

A METHOD OF DISCRIMINATING BETWEEN BUTTERINE AND PURE BUTTER.

By JOHN HORSLEY, F.C.S., Cheltenham.

This method enables anyone to put it into practice. Have ready two small but wide-mouthed glass test-tubes, about four inches high, with feet attached. Into one put a piece of butterine, or oleo-margarine (about the size of a hazel nut), and cork this tube: into the other put a similar sized piece of pure butter, and cork that tube; next take one in each hand at the bottom: in ten minutes the butterine melts into a clear oily fluid by the mere heat of the blood (98° F.). Pure butter takes twice as long to melt as butterine, and even then is not so clear and oily as butterine, which is a noteworthy difference between them; this is the physical test. For the chemical test, after the tubes have stood to cool for a few minutes, pour on ether to about one-third of the tube, and cork well. Agitate the tubes—one in each hand—clasping them well. The butterine readily dissolves into a clear liquor, which the addition thereto of 20 or 30 drops of spirit of wine does not disturb or precipitate; but a similar experiment with pure butter produces a voluminous white precipitate. Hereby we can easily distinguish one from the other. Even butter adulterated with a portion of oleo-margarine or butterine may be detected by a precipitate being formed.

IODISED TANNIC ACID AS A REAGENT.

By Dr. O. SCHWEISSINGER.

If alcoholic solutions of iodine and of tannin are mixed together in equal volumes, and if 2 drops of the mixture are added to 20 c.c. of spring-water, a rose colour is produced, which disappears again in a short time. Distilled water does not give this reaction. Further experiments showed that this reaction is occasioned by all alkalies and alkaline earths, and their carbonates, bicarbonates, borates, and phosphates,—in short, by all salts which have a slight alkaline reaction. If 1 part of potassium carbonate is dissolved in 100,000 parts of water, 20 c.c. of the solution gave an intense rose colour with 2 drops of the reagent. Even at a dilution of 1 : 1,000,000 the reaction was still manifest. Sulphates and chlorides do not give this reaction, but their presence in small quantities does not interfere. The rose colour is distinguishable in dilute solutions only; in strong ones it is masked by a brown colour.—*Pharm. Zeitung* and *Chemiker Zeitung*.

THE PHENOLS AS REAGENTS FOR CARBO-HYDRATES.

By Prof. ANTON IHL.

In every case an alcoholic solution of the phenol in question was mixed with the finely-powdered carbohydrate and with hydrochloric acid, and cautiously heated. α-Naphthol gives with cane-sugar, even at a gentle heat, a splendid red-violet colour, which disappears on the addition of water; with milk-sugar, a fine violet colour; with dextrin, on boiling, a splendid blue colour; with arabin, on prolonged boiling, a red colour; and with starch, a deep reddish violet.

β-Naphthol gives with cane-sugar a yellow colour, which on prolonged boiling turns to a dark greenish yellow with a greenish fluorescence; with milk-sugar, a pure yellow, without fluorescence; with glucose, a yellowish green colour, with a strong green fluorescence; with dextrin, a yellowish colouration; with arabin, a light yellow; and with starch a faint yellow.

Rescorcin yields with cane-sugar an intense fiery-red colour, which retains its colour on dilution with water; with milk-sugar, glucose, dextrin, arabin, and starch, yellowish red colours.

Pyrogallic acid gives with cane-sugar a fine red colour, permanent on the addition of water; with milk-sugar, glucose, dextrin, arabin, and starch, yellowish red colours.

Phloroglucine yields with cane-sugar on gently heating an intense yellow-red colour, which on dilution with water turns to a fine light yellow; with milk-sugar, a red-brown colour; with glucose, a yellowish red; with dextrin, a slight dirty yellow; and with arabin, on prolonged heating, an intense cochineal-red dye, which is permanent on the addition of water.—*Chemiker Zeitung.*

ON GALLIUM.

By Dr. L. EHRLICH.

The author, working in the establishment of Dr. Schuchardt, has for the first time succeeded in isolating gallium by an industrial procedure. A preliminary experiment yielded 0·6 grm. gallium from 80 kilos. of zinc blende. Lecoq de Boisbaudran obtained 1 grm. from 100 kilos. The author followed the method of L. de Boisbaudran with a few modifications, and when operating upon several cwts. of blende, succeeded in simplifying the process, so that it became possible within two or three days, after lixiviation of the zinc sulphate, to concentrate the gallium of 6 cwts. of blende in a relatively small quantity of a mud containing ferric oxide. On the electrolysis of the galliferous alkaline solution the metal was deposited on the negative electrode, which was of the size of 14 square c.m. As a positive electrode the author used a platinum capsule of about 15 c.m. in diameter. The metal is deposited especially at the corners of the electrode in fine needles about 2 to 3 m.m. in length, and both sides of the plate are covered with a metallic sponge. After washing the electrode with water and alcohol, the metal when being dried near a flame could be melted into small globules. A thermometer hanging near marked 30°. The melting-point of gallium is 30·5°. The lustre of gallium globules is greater than that of mercury.—*Chemiker Zeitung.*

DETERMINATION OF ARSENIC IN IRON AND IRON ORES.

By E. LUNDIN.

The author has combined Puller's method of weighing the arsenic directly as arsenic sulphide and Almen's modification of Schneider's distillation method, and worked out the combined process for the above purpose. He proceeds as follows:—6 grms. of crude iron, bar iron, or steel are dissolved in about 70 c.c. nitric acid at 1·2 sp. gr. in a beaker containing about 300 c.c. When dissolved the product is rinsed into a porcelain capsule holding 150 c.c., mixed with 40 to 45 c.c. sulphuric acid at 1·83, and heated until the last trace of nitric acid is expelled, stirring diligently with a glass rod. The capsule is then placed on a sand-bath, and the evaporation continued until a part of the sulphuric acid is driven off and bubbles no longer appear in the mass. If clots form, 5 to 10 c.c. of sulphuric acid are added, which does not produce an escape of arsenic.

The residual mass, thus perfectly freed from nitric acid, is placed in a flat-bottomed flask holding 300 c.c. 8 to 12 c.c. finely ground ferrous sulphate must be added to reduce the arsenic acid, and after adding 70 c.c. pure hydrochloric acid of sp. gr. 1·19 it is distilled through an elbowed glass tube (fixed air-tight in the mouth of the flask by means of a caoutchouc stopper) into a pipette holding about 50 c.c. Its point goes into a beaker containing 300 c.c. of distilled water, and passing about 12 m.m. below the surface. When the wide part of the pipette begins to grow warm all the arsenic has passed over as terchloride, which generally takes fifteen to twenty minutes. The solution of arsenic thus obtained is heated to 60° to 70°, and a rapid current of sulphuretted hydrogen is introduced until the precipitate has completely settled. If the supernatant liquid is not perfectly clear all the nitric acid has not been expelled, and it is to be feared that all the arsenic has been carried over. Further, in this case the arsenic sulphide obtained cannot be weighed directly, but must be purified or converted into some other compound.

When the solution is saturated with hydrogen sulphide the heat is kept up, and a current of carbonic acid is passed in until the odour of hydrogen sulphide is scarcely perceptible. The precipitate is placed upon a tared filter, dried at 100° to 110°, and weighed.

Ores are treated in the same manner, but the method of solution is different, as they are ground to a fine powder, and steeped for twelve hours in nitric acid at 1·4 sp. gr., that at 1·2 being afterwards added.—*Jern. Kontorets Annaler* and *Chemiker Zeitung.*

SEPARATION AND DETERMINATION OF METHYLIC ALCOHOL IN PRESENCE OF ETHYLIC ALCOHOL.

By C. De PONCY.

The process is based on the fact that methyl oxalate dissolves readily in water, whilst ethyl oxalate is sparingly soluble, and both oxalates form with ammonia amides perfectly insoluble in water. In 10 c.c. of the alcohol in question there are dissolved 10·8 grms. oxalic acid, and the solution is saturated with hydrochloric acid gas. After standing for 24 hours in a well-stoppered bottle, 2 c.c. of the solution are mixed with 10 c.c. of water, shaken up and filtered. As methyl oxalate is completely soluble in water, there is obtained, on adding ammonia, more amide than if an equal quantity of pure ethylic alcohol had been employed. By a number of experiments we may ascertain the quantity of oxamide formed in the washing waters of the ethylic oxalates. For absolute alcohol the mean is 6·6. For methyl oxalate the mean is from 14·65, and 15 per cent on the quantity of the methylic alcohol.

If a mixture of methylic and ethylic alcohols is etherified, shaken up with water, and the filtrate mixed with ammonia to precipitate the amides, the proportion of methylic alcohol may be calculated from the quantity of oxamide obtained. For every one per cent of methylic alcohol we obtain from 0·14 to 0·15, more than 6·6 per cent.—*Génie Civil* and *Chemiker Zeitung.*

THE VOLUMETRIC DETERMINATION OF TIN, AND ON CERTAIN STANNOUS SALTS.

By T. BENAS.

The sole cause of the irregularities observed on titrating acid stannous solutions is the oxygen, and not merely that contained in the solution of tin, but that in the standard solution, and in case of concentrated solutions that absorbed by the surface of the liquid from the air during the process of titration. The statement of Lenssen that stannous oxide in acid solutions cannot be completely converted into stannic oxide is erroneous. Also in the method proposed by Lenssen and recommended by Mohr as free from faults, *i.e.*, the titration of tin with iodine in an alkaline solution, oxygen occasions similar irregularities as in acid solutions. Trustworthy results can be obtained only by the exclusion of oxygen, or by the utmost possible reduction of its influence. This is best effected, in case of acid solutions, by dissolving the stannous compound in question in water containing hydrochloric acid and free from air, and then adding immediately an excess of the iodine solution. The excess of the latter is then determined in the ordinary manner by titration with hyposulphite. The dilution is preferably such that 100 c.c. water go to 250 m.g. of the salt.—*Chem. Centralblatt* and *Chemiker Zeitung*.

PROCEEDINGS OF SOCIETIES.

PHYSICAL SOCIETY.

Ordinary Meeting, February 28th, 1885.

Prof. Guthrie, President, in the Chair.

Messrs. G. R. Begley and O. Chadwick were elected Members of the Society.

Mr. J. C. McConnel presented two notes on "*The Use of Nicol's Prism.*" The first note related to the error in measuring a rotation of the plane of polarisation due to the axis of rotation of the prism not being parallel to the emergent light. After pointing out that this error was to a first approximation eliminated by taking the mean of the readings in the two opposite positions of the Nicol, the author proceeded to push the calculation to a second approximation, so as to get a measure of the residual error. This is given by the equation—

$$\frac{\theta + \theta_1}{2} - \psi = \text{const.} + 0{\cdot}24\, r^2 \sin\psi \cos\psi.$$

Where θ and $180 + \theta_1$ are the two readings of the circle; ψ the angle between the plane of polarisation and a fixed plane; and r the angle between the axis of rotation and the incident light. This equation is practically correct for a flat-ended as well as an ordinary Nicol. The residual error cannot amount to 1′ in a rotation of 60° if r is less than 2°. The optical properties of the Nicol tend to neutralise the geometrical error due to the rotation taking place about one axis and being measured about another.

The second note dealt with a new method of obtaining the zero reading of a Nicol circle. This is often defined as the reading when the plane of polarisation is parallel to the axis of rotation of the table of a spectrometer. A Nicol is fixed on the table, the light quenched by turning the Nicol circle, and the reading taken. The table is then rotated through 180°, the light quenched, and the reading taken again. The mean of the two readings gives the result required. It was described how the error due to the want of symmetry of the Nicol might be found and eliminated.

Mr. H. G. Madan exhibited and described "*Some New Forms of Polarising Prisms.*" The first of these is by M. Bertrand, and has been described by him (*Comptes Rendus*, Sept. 29, 1884). The prism consists of a parallelopiped of dense flint glass, of refractive index 1·658, the same as that of Iceland spar for the ordinary ray. The glass prism is cut like the spar of a Nicol's prism, a cleavage plate of spar being cemented between the two halves, by an organic cement of refractive power slightly greater than 1·658. A beam of light traversing the prism is incident upon the spar at an angle of 76° 44′. The ordinary ray passes through without change, but the extraordinary ray is totally reflected at the first surface. The prism gives a field of 40°. M. Bertrand's prism has the great advantage of requiring only a very small quantity of Iceland spar, a substance that is becoming very scarce and expensive.

The other prisms shown were a similar one by M. Bertrand, described in the same paper, a double image prism by Ahrens, described in the *Phil. Mag.*, for January, 1885, and a modification of the latter by Mr. Madan, described in *Nature* for February 19.

Mr. Lewis Wright pointed out as a practical objection to M. Bertrand's prism that it was very doubtful whether a glass could be obtained of so high a density as to possess a refractive index of 1·658, and at the same time be colourless and unaffected by the atmosphere. He also remarked that the principle of the prism was by no means new.

Prof. W. E. Ayrton read a paper by himself and Prof. J. Perry, "*On the most Economical Potential Difference to employ with Incandescent Lamps.*" The authors commenced by pointing out the importance of experiments being made on the lives of incandescent lamps in addition to experiments on efficiency. Referring to the experiments on life given by M. Foussat in *The Electrician* for Jan. 31, they showed that if p be the price of a lamp, in pounds, n the number of hours per year that it burns, $f(v)$ the life of the lamp in hours, and $\theta(v)$ the number of candles equivalent to the lamp, $f(v)$ and $\theta(v)$ being expressed as a function of the potential difference in volts,—

$$\frac{p \times n}{f(v) \times \theta(v)}$$

stands for the cost per year per candle, as far as the renewal of lamps is concerned. Also, if H stands for the cost of an electric horse-power per year for the number of hours electric force is employed, and $\phi(v)$ the number of Watts per candle,—

$$\frac{\mathrm{H}}{746} \times \phi(v)$$

stands for the cost per year per candle as far as the production of power is concerned. The sum of these two represents the total cost per candle per year and the value of v that makes this a minimum may be found either graphically or analytically. Solving the problem graphically, for the 108 volt Edison lamps used at the Finsbury Technical College, where n may be taken as 560, and H = £5, they find that the minimum value of the total cost is given by $v = 106$. The curve connecting total yearly cost per candle with v they found to be very flat at this point, showing that the lamps may be burnt with a potential difference varying as much as 4 volts with only 5 per cent addition to the annual cost. It is found that with certain types of incandescent lamps the candle-power of the lamp varies as the potential difference *minus* a constant. The authors also find that in rough photometric experiments No. 8 sperm candles may be substituted for standard ones.

Mr. Macfarlane Gray gave an account of a most extended investigation upon the second law of thermodynamics. From considerations connected with the specific heats of liquids and gases, the author comes to the conclusion that the law is not true. The experimental results used are chiefly those of Regnault, to which, however, Mr. Gray has applied some corrections.

CORRESPONDENCE.

THE NEW PATENT LAW.

To the Editor of the Chemical News.

Sir,—I am obliged by your review of the "Patentees, Manual," in the Chemical News, vol. li., p. 104. You are quite right in supposing that I consider it no part of the duty of authors of a book of this kind to enter into arguments with respect to the value of the alterations, or to state what further alterations in the law seem to be desirable. There is great difference of opinion on all these points, and, so far as I can see from your review, you and I would differ considerably upon the points of alteration effected by the recent Act and the remedies you would suggest for them. I quite agree with you that the omission from the Patent Office Journal of the List of Foreign Patents is extremely unfortunate. I called the attention of the Comptroller to it when it first began, and he then told me that the reason for the omission was that the journal to be published under the auspices of the International Office of the Union for the Protection of Industrial Property, published at Berne, would give all these lists.

This journal has now made its appearance without any of them, and I have again written to the Comptroller on the subject, and will endeavour to get the influence of the Institute of Patent Agents brought to bear upon him and upon the Board of Trade for the re-insertion of these lists.—I am, &c.,

J. Henry Johnson.

47, Lincoln's Inn Fields, London, W.C.,
March 2, 1885.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

Note.—All degrees of temperature are Centigrade unless otherwise expressed.

Comptes Rendus Hebdomadaires des Séances, de l'Académie des Sciences. Vol. c., No. 5, February 2, 1885.

On a Selenium Actinometer.—H. Morize.—The purpose of this instrument is to measure the relative intensity of the luminous solar rays at different heights above the horizon. The selenium actinometer consists of a cylinder of selenium prepared according to Bell's process; *i.e.*, 38 discs of copper are insulated from each other by means of discs of mica; these latter being of a less radius the channel thus left between two coppers is filled with selenium by rubbing the cylinder over with a rod of this substance. When the cylinder has been suitably annealed the selenium takes a greyish aspect and is ready for use. The copper discs of the even series and those of the odd series are respectively connected by means of conductors. By this arrangement the resistance of the selenium is decreased and the sensitiveness of the apparatus is heightened by augmenting the number of the discs and that of the ridges of selenium. The cylinder is fixed on insulating glass feet in a glass case from which the air has been exhausted in order to eliminate the disturbing influence of dark heat-rays. The whole is placed on a support sufficiently high to escape the effects of the light reflected by neighbouring objects. The case is fixed in such a manner that its axis is parallel to the axis of the globe, so that at every hour of the day the luminous rays may fall almost normally upon the selenium and illuminate always the same portion. By a slight movement in the plane of the meridian the cylinder may even be brought daily into such a position that the luminous rays are absolutely normal to its surface. If we then pass a constant current through this apparatus and through a galvanometer the latter will indicate by its deviations all the variations of the illumination of the selenium. In order to compare these variations a scale must be adopted. If we suppose the selenium placed in perfect darkness its resistance will be at its maximum and the deviation of the galvanometer at a minimum. We mark this point of absolute darkness as zero. The greatest effect which light can produce will be to annul the resistance of the selenium. If we therefore withdraw the latter from the circuit we obtain a deflection which we mark as 100 or maximum light. If the interval between 0 and 100 be divided into 100 equal parts we obtain actinometric degrees which are always comparable. In practice the Clamond battery should be employed. During the determination of the zero and 100 points the external portion of the apparatus should be kept at 0°, and by repeating these determinations at different temperatures a table may be constructed for referring the actinometric degree obtained at any temperature to what it would be if the apparatus were at 0°.

New Preparation of Phosphorus Trifluoride and on the Analysis of this Gas.—H. Moissan.—The author lets fall arsenic fluoride drop by drop into a small perfectly dry flask containing phosphorus trichloride. The mixture becomes hot, and the gas evolved traverses a long tube kept at −15°, and is then collected over mercury. Some of the specimens obtained gave on analysis PF_3. This proportion was the maximum of fluorine.

The Green Ferrocyanides or Glauco-ferrocyanides.—MM. Etard and G. Bemont.—On evaporating for twenty days in the water-bath a solution of equal parts of ammonium chloride and potassium ferrocyanide there is deposited a green powder which, when washed and dried, has the composition $C_{20}N_{25}H_{24}Fe_6K_2O$.

On Vincetoxine.—Ch. Tanret.—This compound is a glucoside obtained from the root of the Asclepias. When split up by acids it yields a glucose which is amorphous, optically inactive, and not fermentible. In presence of the mineral acids it is precipitated like an alkaloid by potassium-mercury iodide and by iodised potassium iodide. It has the same percentage composition as glycyrrhizine.

The Signification of Polarimetric Experiments Executed with the Solution of Cotton in the Cuprammonic Reagent. Polarimetric Experiments with this Reagent.—A. Béchamp.—The author concludes from his experiments that the cuprammonic reagent really acts upon polarised light, and is therefore optically active. The deviation is sometimes to the left and sometimes to the right. The optical effects produced upon polarised light by the solution of cotton in this reagent depend upon the optical activity of the solvent, though they are modified by the cotton, just as the rotatory properties of other bodies are modified by agents devoid of the same power.

A Particular Case of Catalytic Action.—M. Lorin.—A controversial paper in reply to M. Van Romburgh with reference to the author's paper on the preparation of crystalline formic acid (*Comptes Rendus* for June, 1881).

Composition of the Ash of the Equisetaceæ with Reference to the Coal Formation.—M. Dieulafait.—The author examined the ash of the *Equisetaceæ* in order to solve the questions why coal is exceptionally saturated with sulphur compound and is at the same time poor in alkaline carbonates. He obtained 320 specimens of the modern representatives of this family, grown on the most varied soils, from the Vosges to the southern slope of the Pyrenees, from both slopes of the Alps, from Corsica, Tuscany, and the African coast from Bona to Algiers. The mean results from the ash of 118 specimens contained on the average—Potassium sulphate, 12·00; calcium sulphate, 14·30. The proportion of sulphuric acid is therefore 13·91 per cent, whilst in the ash of plants of the modern epoch the sulphuric acid does not exceed 1 per cent. These results explain the origin of the excess of sulphur and of calcium sulphate found in all coals.

Bulletin de la Société Chimique de Paris,
Vol. xliii., No. 2, January 20, 1885.

Rapid Determination of Solids by means of a Vacuum.—J. Peters.—For determining the solid matter in wine, milk, beer, vinegar, urine, &c., the author proposes a modification of the process of Armand Gautier: the watch-glasses in which the evaporation is to be effected being 0·08 metre in diameter, a certain number of plain filters are cut of 0·035 metre radius. Whilst they are folded in eight an incision is made following the eight radii, from the circumference almost to the centre, so that the discs obtained are composed of eight sectors, united at the angle. These discs are then placed in an exsiccator over lime or sulphuric acid. When they are about to be used, the paper is quickly withdrawn from the exsiccator, placed between two watch-glasses, which are held together by a clip, and tared. The disc is then opened out, placed in one of the watch-glasses, and 5 c.c. of the liquid in question are poured over it. It is then placed under the vacuum bell over the sulphuric acid. Not more than six or eight such watch-glasses should be placed under an Alvergniat or Golaz bell along with two crystallising pans of sulphuric acid, the one above and the other below the watch-glasses. The evaporation is so active that after the lapse of three or four hours no liquid remains. It is then necessary either to change the sulphuric acid and exhaust again, or else to agitate the acid in such a manner as to mix the upper aqueous layer with the lower strata. This is easily effected by putting in the acid pans a number of glass balls, of a diameter rather greater than the depth of the acid, and giving them, when required, a gentle rotatory movement by displacing the bell. The glass is allowed to remain a night in the vacuum, and is then weighed, after having allowed dry air to enter the bell, and having clasped the second watch-glass over the one containing the sample, as was done when taring the paper. The paper discs, placed in the exsiccator over lime, &c., still lose from 0·001 to 0·0015 grm. in the vacuum, which raises the weight of the extract by 0·2 to 0·3 grm. per litre, for which a correction can be made.

Colorimetric Process for the Determination of Manganese.—M. Osmond.—This paper will be inserted in full.

Justus Liebig's Annalen der Chemie,
Vol. 207, Parts 1 and 2.

Communications from the Chemical Institute of the University of Strassburg.—These comprise papers by Leo Woringer, on camphanic acid; by F. Roeder, on the synthesis of vinaconic acid, an isomer of itaconic acid; by R. Fittig, on the constitution of vinaconic acid; and by L. Weinstein, on α- and β-hydropiperic acid. There are also a series of papers contributing to the knowledge of Perkin's reaction: *i.e.*, one by F. L Slocum, on the formation of phenyl-angelic acid and phenyl-methacrylic acid, and on the behaviour of acetyl-phenyl-lactic acid; by P. Otto, on phenyl-oxypinalic acid and certain of its derivatives; and by Aug. Schneegans, on Perkin's reaction in the fatty series.

Communications from the University Laboratory of Wurzburg.—These include papers by E. L. Neugebauer, on ethyl-ester and the amide of normal γ-oxyvalerianic acid; by W. Allen and A. Kölliker, on certain derivatives of triphenyl-carbin bromide; by F. F. Regelsberger, on certain ammoniacal compounds of uranyl chloride; and by A. Terrisse, on naphthal-fluoresceine and naphthal-eosine. The last-mentioned investigation will probably have an important bearing on the tinctorial arts. The author has studied the action of naphthalic anhydride upon resorcin, and has obtained compounds analogous to those produced by phthalic anhydride. He first prepares acenaphthene by the method of Behr and Dorp as modified by Reingruber. He then prepares naphthalic acid by oxidising acenaphthene with a mixture of chromic and sulphuric acids, and renders it anhydrous by sublimation. One part of naphthalic anhydride heated with three parts resorcin for three hours to temperatures between 260 and 270° yields naphthal-fluoresceine. The reaction may be effected in an hour to an hour and a-half at a temperature of 215° if a little zinc chloride is added to the mixture. Naphthal-fluoresceine is a brittle resin, which has a greenish reflection, and which dissolves in hot dilute soda-lye with a reddish brown colour. From the cold solution it may be precipitated in orange-yellow flakes by the addition of an excess of hydrochloric acid. If 4 mols. bromine are added to a cold alcoholic solution of naphthal-fluoresceine the liquid turns red, and deposits flat, golden-green crystalline needles of tetra-brom-naphthal-fluoresceine, that is, naphthal-eosine. This compound is sparingly soluble in alcohol and ether, but readily in alkaline lyes and their carbonates. The solution appears yellowish red by transmitted light and yellow by reflection, but in very dilute solutions it appears carmine-red. Solutions of its alkaline salts dye silk a splendid fiery red, with a bluish reflection, considerably more beautiful than the shade produced by a corresponding quantity of the ordinary phthalic eosine.

The Higher Phenols contained in Coal-tar.—K. E. Schulze.—An examination of the anthracene-oil freed from crude anthracene by filtration. The author, contrary to his expectation, discovered a considerable quantity of the oxy-derivatives of naphthalin,—a fact not in harmony with the present theory concerning the formation of hydrocarbons in the distillation of coal-tar.

On Dicinchonine.—The author views dicinchonine as intermediate between cinchonin and cinchonicine, but approaching more closely to the latter. Its conversion into cinchonicine has not, however, been found practicable.

The Decomposition of Aqueous Solutions of Hypochloric Acid and of Chlorine in Sunlight.—A. Popper.—Chlorine water, decolourised in sunshine, neutralised with potassa, and finally evaporated down, leaves a saline residue consisting of potassium chloride and chlorate; the perchlorate is not present. A solution of hypochloric acid yields on exposure to light, in the first place, chloric acid, free chlorine, and oxygen. Small quantities of perchloric acid are then formed from the chloric acid and the oxygen, and the free chlorine reacts upon the water, generating hydrochloric acid and a fresh quantity of chloric acid and oxygen.

Action of Phthalic Anhydride upon the Secondary Monamines.—A. Piutti.—This paper does not admit of useful abstraction.

The Behaviour of Lupinidine with Ethyl Iodide.—G. Baumert.—Lupinidine, like berberine, forms a hydriodate with ethyl iodide.

Researches on Milk Sugar, and Galactose.—Dr. W. H. Kent and B. Tollens.—The best proportions for the production of mucic acid are 100 grms. of milk sugar with 1200 c.c. nitric acid at 1·15. Milk sugar, if boiled with dilute sulphuric or hydrochloric acid, yields, along with galactose, dextrose. Galactose yields with nitric acid about double the quantity of mucic acid obtained from milk sugar. On boiling with hydrochloric acid galactose yields lævulinic acid. On heating mucic acid to high temperatures in water, it is decomposed with the formation of dehydro-mucic acid, pyro-mucic acid, and other bodies.

Archives Neerlandaises des Sciences Exactes et Naturelles.
Tome xix., Part 2.

This issue contains no chemical matter.

Cosmos les Mondes.
No. 16, December 27, 1884.

New Process of Practical Spectroscopy.—E. Demarçay.—Already noticed under the *Comptes Rendus.*

New Series, Nos. 1, 2, 3, and 4.

A New Battery.—M. de Sainte Marie proposes a battery of which the positive pole is of lead surrounded with lead chlorate, and the negative pole of zinc, plunging into a solution of lead chloride.

Terrestrial Currents.—M. Leblond has detected, by means of lines analogous to telegraph lines, but with extremities plunging into the sea, periodical variations of intensity in direct relation with the movement of the moon or the tides.

Novel Sophistication.—It is stated that in Paris vaseline has been introduced by pastry-cooks as a substitute for butter, lard, oil, &c. It cannot become rancid, but it is indigestible and incapable of assimilation.

Bulletin de la Société d'Encouragement pour l'Industrie Nationale. 3rd Série. Tome xi., November, 1884.

This issue contains no chemical matter except certain extracts from the *Journal of the Society of Chemical Industry.*

December, 1884.

This issue also contains no original chemical matter.

Revue Universelle des Mines, de la Metallurgie, &c., November and December, 1884.

This number contains no chemical matter.

MISCELLANEOUS.

New Distinction between Natural Wines and those Fabricated with the Addition of Water.—Dr. Egger.—Pure natural wines contain three inorganic acids, the phosphoric, sulphuric, and silicic, but not nitric. As the water used in sophisticating wines is almost exclusively taken from pump-wells, contaminated with the impurities of the adjoining soil an addition of water may be inferred if wine is found to contain nitric acid. The author decolourises the wine in question with animal charcoal, evaporates down, removes albumenoids and salts by means of alcohol, and tests for nitric acid by Kopp's method with diphenylamine in sulphuric acid.—*Archiv. Hygiene* and *Chemiker Zeitung.*

Modifications Produced in the Composition of Certain Animal Fluids under the Influence of Epidemic Cholera.—A. Gabriel Pouchet.—The urine during the cold period contains only 1-10th of the sodium chloride normally present. The following substances not normally present in urine have been recognised :—biliary salts, albumen, sometimes 5 and 9 grms. per litre, a small quantity of glucose, and a peculiar albumenoid substance. Only an extremely small quantity of a fixed alkaloid has been obtained. The serum of the blood contains a relatively considerable quantity of biliary salts. Asiatic cholera appears to be characterised by extremely intense processes of reduction.—*Comptes Rendus,* vol. c., No. 6.

The Chemical Laboratory of Wiesbaden.—In the Winter Term, 1884-85, there were 89 students on the books. Of these, 67 were from Germany, 7 from England, 5 from Austro-Hungary, 3 from North America, 2 from France and Russia, and 1 from Switzerland, Luxemburg, and Sweden. Besides the director, Geh. Hofrath Prof. Dr. R. Fresenius, there are engaged as teachers in the establishment Dr. H. Fresenius, Dr. E. Borgmann, Dr. W. Fresenius, Dr. E. Hintz, Dr. med. F. Hueppe, and Architect Brahm. The assistants in the instruction laboratory were two in number, in the private laboratory 11, and in the Versuchsstation, 2. All departments, also the new ones for organic chemistry and hygiene, were well frequented. During the last term, besides the scientific researches, a great number of analyses were undertaken in the laboratory and the Versuchsstation on behalf of manufacture, trade, mining, and agriculture.

Erratum.—P. 106, col. 1, line 39 from top, *for* "destructive" *read* "distinctive."

MEETINGS FOR THE WEEK

Monday, 9th.—Medical, 8.30.
—— London Institution, 5.
—— Society of Arts, 8 (Cantor Lectures.) "Carving and Furniture," by J. Hungerford Pollen.
Tuesday, 10th.—Royal Institution, 3. "Digestion and Nutrition," by Prof. Gamgee.
—— Royal Medical and Chirurgical, 8 30.
—— Institution of Civil Engineers, 8.
—— Photographic, 8.
Wednesday, 11th.—Society of Arts, 8. "Exploration, and the Best Outfit for such Work," by Major-Gen. the Hon. W. Feilding.
—— Geological, 8.
—— Microscopical, 8.
Thursday, 12th.—London Institution, 5 and 7.
—— Royal, 4.30.
—— Royal Institution, 3. "The New Chemistry," by Prof. Dewar.
—— Royal Society Club, 6.30.
—— Society of Arts, 8. "Recent Improvements in Photographic Development," by W. K. Burton.
Friday, 13th.—Royal Institution, 8. "Accidental Explosions caused by Non-explosive Liquids," Sir Fredk. Abel, at 9.
—— Society of Arts, 8. "The Present Condition and Future Prospects of Female Education in India," by Mancherjee M. Bhownaggree.
—— Quekett Club, 8.
Saturday, 14th.—Royal Institution, 3. "Richard Wagner," by Mr. C. Armbruster.
—— Physical, 3. Discussion on Profs. Ayrton and Perry's paper on "The Most Economic Potential Difference to Employ for Incandescent Lamps." Further Lecture Experiments on Spectrum Analysis," by C. Cleminshaw.

TO CORRESPONDENTS.

R. W. O.—Professor Leeds gave no drawing of the apparatus referred to.

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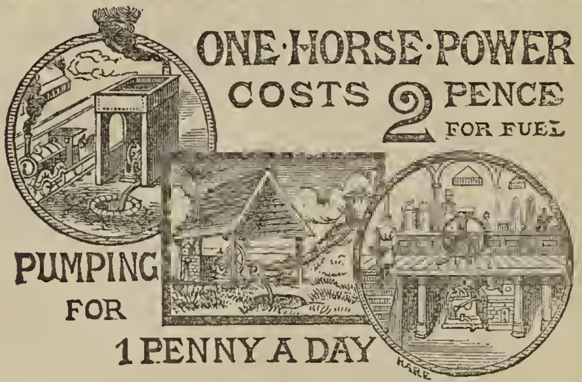

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THE CHEMICAL NEWS.

Vol. LI. No. 1320.

ON THE ATOMIC WEIGHT OF GLUCINUM (BERYLLIUM).

Second Paper.*

By T. S. HUMPIDGE, Ph.D., B.Sc.
Professor of Chemistry in the University College of Wales, Aberystwyth.

This paper is a continuation of one previously communicated to the Royal Society.† The author has prepared a sample of metallic glucinum, having the composition—

Gl	99·20
GlO	0·70
Fe	0·20
	100·00

and has determined its specific heat at varying temperatures up to 450° with the following results (for pure glucinum):—

c^{11}_{100}	0·4286
c^{13}_{145}	0·4515
c^{11}_{193}	0·4696
c^{15}_{240}	0·4885
c^{14}_{312}	0·5105
c^{11}_{360}	0·5199
c^{17}_{447}	0·5403

These results correspond to the following empirical formula for the true specific heat of the metal at varying temperatures—

$$k_t = k_0 + 2\alpha t + 3\beta t^2,$$

or with numerical values—

$$k_t = 0{\cdot}3756 + 0{\cdot}00106t + 0{\cdot}00000114t^2,$$

whence the following values for k_t are calculated:—

k_0	0·3756
k_{100}	0·4702
k_{200}	0·5420
k_{300}	0·5910
k_{400}	0·6172
k_{500}	0·6206

In a curve these values are graphically represented. The curve reaches a maximum at about 470°, and then falls; but whether it represents the specific heat at higher temperatures than 500° is doubtful. The specific heat of glucinum thus rises rapidly up to about 400°, and remains approximately constant between 400° and 500° at 0·62. If this number is multiplied by 9·1 it gives the atomic heat 5·64. Glucinum, therefore, belongs to the same class as carbon, boron, and silicon, which agree with Dulong and Petit's rule at high temperatures only. And the true atomic weight is that required by the periodic law, viz., 9·1 and not 13·6, as was previously deduced from the specific heat between 10° and 100°.

This conclusion is confirmed by the author's determinations of the vapour-densities of glucinum chloride and bromide in a platinum vessel. The experiments were done in an atmosphere of carbonic acid collected over mercury after Meier and Crafts,‡ and gave the following results:—

I. *Glucinum Chloride.*

	Substance.	Displaced CO_2.	*t.*	*d.*
Experiment i. ..	26·4 m.grms.	7·47 c.c.	635°	2·733
,, ii. ..	28·0 ,,	7·98 ,,	785	2·714

The theoretical density of $Gl''Cl_2$ is 2·76, and this formula, therefore, represents the molecule of this compound:—

II. *Glucinum Bromide.*

	Substance.	Displaced CO_2.	*t.*	*d.*
Experiment ii. ..	35·9 m.grms.	4·28 c.c.	608°	6·487
,, iii. ..	61·1 ,,	7·53 ,,	630	6·276
,, iv. ..	26·0 ,,	3·22 ,,	606	6·245

The density of $Gl''Br_2$ is 5·84, and that of $Gl'''Br_3$ is 8·76. The agreement in this case is not so close as in the case of the chloride, but is sufficiently near to show that the true molecular formula is $Gl''Br_2$, and not $Gl'''Br_3$. Thus, the vapour density of both compounds necessitates the atomic weight 9·1. The result is a striking argument in favour of the value of deductions drawn from the periodic law in regard to the atomic weight of an element, and shows that such deductions will in future form one of the most important factors in fixing a doubtful atomic weight. The author did not appreciate the full value of the periodic law when he wrote his former paper, otherwise he would probably have stated his conclusions less positively.

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* Abstract of a Paper read before the Royal Society, March 5, 1885.

† *Proc. Roy. Soc.*, vol. 35, p. 137. Chemical News, vol. xlvii., pp. 181, 297.

‡ *Berlin Ber.*, xiii., 851.

ON THE EXTRACTION OF URIC ACID CRYSTALS FROM THE GREEN GLAND OF *ASTACUS FLUVIATILIS*.*

By A. B. GRIFFITHS, Ph.D., F.C.S.
Lecturer on Chemistry and Physics, Technical College, Manchester.

The so-called green glands of the fresh water crayfish lie in the cavity of the head below the front part of the cardiac division of the stomach. The openings of these organs are to be found at the base of each antenna. The organ carefully dissected out of the head of a freshly killed crayfish is seen to consist of two principal parts: an uppermost one which is a transparent and delicate sac-like body filled with a clear fluid, and an underlying portion of a green colour, glandular in appearance, containing granular cells.

In 1848 Professors Will and Gorup-Besanez (see *München Gelehrte Anzeigen*, No. 233, 1848) said that this organ probably contained guanin, and from this supposition this green gland has been considered as a secretory organ.

The secretion of this gland is acid to litmus-paper, and on treating the secretions obtained from a large number of green glands with hot dilute sodium hydrate solution, and then adding hydrochloric acid, a slight flaky precipitate was obtained, and on examining these flakes under the microscope they were seen to consist of small crystals in rhombic plates. On treating the secretion with alcohol, these rhombic crystals are deposited; they are soluble in boiling water.

When these crystals are precipitated from the secretion and moistened with dilute nitric acid, alloxanthine ($C_8H_4N_4O_7$) is produced, and on heating this body gently with ammonia, reddish-purple *murexide*, or the "ammonium purpurate" ($C_8H_4(NH_4)N_5O_6$) of Prout is obtained. This murexide so obtained crystallises in prisms which, by reflected light, exhibit a splendid green metallic lustre, and by transmitted light are a deep reddish-purple.

On running in a solution of potassium hydrate upon a microscopic slide containing some of these murexide crystals they were dissolved. From these reactions it is evident that these rhombic crystals are deposits of *uric acid* ($C_5H_4N_4O_3$) from the secretion of the green gland of the crayfish.

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* A Paper read before the Royal Society, March 5, 1885.

On examining the uric acid crystals (deposited from the secretion by means of alcohol) under the microscope, they are seen to be covered more or less with a very thin and superficial coating of some brown colouring matter, probably some pigment.

But, beyond this discovery of uric acid in the secretion of the green gland of *Astacus fluviatilis*, I have found that on treating the secretion with boiling hydrochloric acid a solution was obtained containing in suspension flaky uric acid, which was filtered off, and on allowing the filtrate to cool a few crystals (guanin hydrochlorate) separate which are soluble in hot water, and on the addition of ammonia to this hot aqueous solution a precipitate is obtained of *guanin* ($C_5H_5N_5O$), the precipitated guanin being made up of numbers of minute microscopic crystals. On running in warm dilute nitric acid (upon the slide) these crystals disappeared, but were precipitated again on adding a drop of silver nitrate in the form of the nitrate of silver compound ($C_5H_5N_5O,AgNO_3$) of guanin.

I think this investigation proves that this so-called green gland of *Astacus fluviatilis* is a true urinary organ, its secretion containing uric acid and very small traces of the base guanin: the green gland is, therefore, physiologically the kidney of the animal.

ON THE
REDUCTION OF ARSENIC ACID SOLUTIONS.

By LEROY W. McCAY, M.A., D.Sc.

Chemists who have had much experience in estimating arsenic by the ordinary method are well acquainted with the extraordinary difficulty attending the reduction and precipitation of arsenic acid by means of sulphuretted hydrogen. Wöhler, as is well-known, sought to steer clear of this difficulty by a preliminary reduction of the solution under examination with sulphurous acid, it being a well-established fact that the cause of the sluggish precipitation of the arsenic by sulphuretted hydrogen was due to the existence of the metal in the maximum stage of oxidation. Wöhler's proposal, indeed, was that the arsenic acid—in which state the arsenic is almost invariably obtained—should be first reduced to arsenious acid by means of excess of sulphurous acid, and subsequently precipitated as As_2S_3 with sulphuretted hydrogen.

Wöhler's proposal attracted at first much attention, and was highly recommended; later, however, he himself saw fit to give up the use of this reduction agent.[*] I find, too, that in the last edition of "Fresenius's Quantitative Analysis"[†] the use of sulphurous acid as a reduction agent for arsenic acid is not even mentioned, much less recommended.

Some weeks ago I read with much pleasure and gratification an article on the determination of arsenic by Carl Holthof,[‡] in which the subject of reducing arsenic acid by means of sulphurous acid is thoroughly ventilated. Being at that time engaged in subjecting certain compounds, in tightly stoppered bottles and at comparatively high temperatures, to the influence of various oxidising agents, it struck me at once as feasible to try what effect sulphurous acid under pressure would have upon solutions of arsenic acid. To investigate the matter, I made up a solution of hydro-dipotassic arseniate, containing, theoretically, about 9·0 grm. As_2O_5 to the litre. My experiments were conducted as follows:—The arsenic acid was pipetted into a bottle[§] of convenient size, provided with a tightly-fitting ground-glass stopper, and capable of withstanding the pressure corresponding to the heat of a boiling water-bath. Something more than an equal volume of a strong solution of sulphur dioxide gas in water, to which a few drops of dilute sulphuric acid had been added, was then run into the bottle, the same tightly stoppered, well shaken, and the stopper firmly tied down with a piece of strong cord. The bottle with its contents was then placed in the water-bath, the water of which had already been brought to a boil, and were permitted to remain for *exactly one hour.* The flame of the burner during the experiment was so regulated that the water in the bath boiled briskly, but not violently. After the hour was up the bottle containing the arsenic was allowed to cool to such a degree that it caused no inconvenience when held in the hand, and then carefully opened. The contents were emptied into a flask, diluted and boiled down one-half, a large platinum spiral being used, partially to avoid bumping, partially to facilitate the displacement of the sulphur dioxide gas. After cooling and carefully neutralising the solution was tested for As_2O_5, first with argentic nitrate, second with magnesia mixture. In but a single case was I able to obtain a reaction for arsenic acid.

Seven experiments were made, the quantities of As_2O_5 and SO_2 solution taken for each test being as follows:—

I.

5 c.c. As_2O_5 solution.
15 c.c. SO_2 solution.
Arsenic present as As_2O_5 = 0·045 grm.

II.

10 c.c. As_2O_5 solution.
20 c.c. SO_2 solution.
Arsenic present as As_2O_5 = 0·090 grm.

III.

20 c.c. As_2O_5 solution.
30 c.c. SO_2 solution.
Arsenic present as As_2O_5 = 0·180 grm.

IV.

30 c.c. As_2O_5 solution.
40 c.c. SO_2 solution.
Arsenic present as As_2O_5 = 0·270 grm.

V.

40 c.c. As_2O_5 solution.
50 c.c. SO_2 solution.
Arsenic present as As_2O_5 = 0·360 grm.

VI.

50 c.c. As_2O_5 solution.
60 c.c. SO_2 solution.
Arsenic present as As_2O_5 = 0·450 grm.

VII.

100 c.c. As_2O_5 solution.
110 c.c. SO_2 solution.
Arsenic present as As_2O_5 = 0·900 grm.

As already said, in but one of the above seven solutions could I, after boiling off the sulphur dioxide, detect a trace of arsenic acid.

The tests were made as follows:—

1. Ten c.c were pipetted into a perfectly clean test-tube, a sufficient quantity of dilute ammonia to produce a faint alkaline reaction added, and 1 c.c. of a moderately strong solution of argentic nitrate run in. In each case a heavy canary-yellow precipitate of argentic arsenite immediately made its appearance. This precipitate was next caused to disappear by adding cautiously, drop by drop, highly dilute nitric acid—the solution containing the precipitate being well shaken after the addition of each drop. Fresenius says that if argentic arseniate be present it will

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[*] Otto, *Anleitung zur Ausmittelung der Gifte*, 6te Auflage, 1884, s. 160.

[†] Fresenius, "Einleitung zur Quant. Chem. Analyse," 6th Aufl., s. 373, b.

[‡] "Fresenius's Zeits. für Analy. Chemie," 23 Jahrgang, 3 heft, s. 378.

[§] I used in my experiments three bottles: the smallest had a capacity of 50 c.c., the next in size a capacity of 125 c.c., and the largest a capacity of 250 c.c.

remain undissolved. The yellow precipitate dissolved completely, but no residue remained.

2. Twenty c.c. were pipetted into a perfectly clean Nessler cylinder, 5 c.c. dilute hydrochloric acid added, and the solution rendered alkaline with ammonia. The solution was then cooled, and 3 c.c. magnesia mixture added. Excepting experiment VII., there was in no case an indication of a precipitate, spite the fact that each solution, after the addition of the mixture, was allowed to stand twenty-four hours. In the seventh experiment the magnesia mixture produced in the 20 c.c. taken for analysis a *trace* of a precipitate. The solution, during the first three hours, remained clear, but after standing twenty-four hours there appeared on the sides and at the bottom of the glass cylinder a few tiny stars and needles of ammonium magnesium arseniate. The quantity of the salt, however, was so extraordinarily small that upon filtering and dissolving in dilute nitric acid I could obtain no reaction with argentic nitrate.

I am at present engaged in making a thorough study of the Mohr-Holthof method for estimating arsenic, and I trust ere long to say a word more on the subject of reducing arsenic acid solutions with sulphurous acid under pressure.

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VOLUMETRIC DETERMINATION OF PHOSPHORIC ACID IN PRESENCE OF ALKALIES, CALCIUM, MAGNESIUM, IRON, AND ALUMINIUM,

WITH ESPECIAL REFERENCE TO THE VALUATION OF MANURES.

By J. BONGARTZ.

From a volume of the filtered solution of the sample representing 4 grms. of the original substance the phosphates are precipitated by ammonia; the mixture is acidified with acetic acid, let stand for a few minutes, and filtered. The iron and aluminium phosphates thus separated are washed with hot water on the filter until the washings have no longer an acid reaction. The filtrate and washings are then made up to a known volume with water. The aluminium and iron phosphates remaining on the filter are washed into a flask after the paper has been perforated. The filter is then moistened with a few drops of dilute hydrochloric acid, washed with water up to 150 c.c., and the solution of the precipitate in the flask is effected by means of agitation with the addition, if necessary, of a few drops of hydrochloric acid. It is then ready for titration.

For determining the phosphoric acid which exists in the filtrate in combination with alkalies, calcium, and magnesium, a volume of the solution representing 2 grms. of the original substance is introduced into a beaker, a few drops of hydrochloric acid are added, and a slight excess of solutions of iron, alumina, and calcium chloride. The mixture is heated to a boil, and ammonia is dropped in, stirring continually until a strong alkaline reaction is produced, and all the phosphoric acid is precipitated. The precipitate is washed with water to which potassa has been added until the filtrate reacts but very slightly for chlorine. The filter is then perforated, its contents washed into a flask, the filter moistened with a few drops of hydrochloric acid, solution of calcium chloride is added, and the liquid is titrated after the addition of a few drops of the indicators.

The author's method of titration appears from the following:—If free phosphoric acid to which methyl-orange has been added is titrated with solution of potassa until the original red colour has turned to a pale yellow KH_2PO_4 is formed: $H_3PO_4+KOH=KH_2PO_4+H_2O$, whence the phosphoric acid is easily calculated. If then phenol-phthaleine is added, and then potassa until the red colour is produced, we have—

$$K_2HPO_4.KH_2PO_4+KOH=2K_2HPO_4+H_2O.$$

The phosphoric acid may be calculated from the quantity of potassa consumed. If we now add to the liquid drop by drop hydrochloric or sulphuric acid until the red colour (of methyl-orange) reappears, on the addition of potassa, the phosphoric acid may be again calculated from the quantity of potassa used from the disappearance of the methyl-orange red and the appearance of the phenol-phthaleine red.

According to the author it is possible to determine in this manner not merely phosphoric acid in the free state or in combination with potassium or sodium, but even in calcium, magnesium, iron, and aluminium phosphates. If $CaHPO_4$ is dissolved by the addition of hydrochloric acid it passes into—

$$CaH_4(PO_4)_2 : 2CaHPO_4+2HCl=CaH_4(PO_4)_2+CaCl_2.$$

The excess of hydrochloric acid is neutralised by potassa, when the red colouration of the methyl-orange passes into a yellow. If then potassa is added until the permanent faint redness of phenol-phthaleine is produced the following reaction has taken place:—

$$2CaH_4(PO_4)_2+6KOH+2CaCl_2= \\ =Ca_3(PO_4)_2+CaHPO_4+K_2HPO_4+4KCl+6H_2O.$$

The quantity of potassa consumed between the two points (the yellow colouration of the methyl-orange and the reddening of the phenol-phthaleine) is to the phosphoric acid as $3KOH : P_2O_5$. By dropping in hydrochloric acid until the red colour of methyl-orange returns the precipitate is re-dissolved, and the titration can be repeated. In presence of a sufficiency of phosphoric acid it is well known that iron and alumina are precipitated by ammonia as tribasic phosphates, insoluble in acetic acid. If these, after being well washed, are treated with dilute hydrochloric acid they dissolve. If this solution, after the addition of methyl-orange and phenol-phthaleine, is titrated as above, the quantity of potassa consumed between the two terminal points represents the phosphoric acid according to the equation $2KOH : P_2O_5$.—*Archiv. der Pharmacie* and *Chemiker Zeitung*.

ON VOLATILISATION OF ZINC FROM GERMAN-SILVER ALLOYS.

By A. R. HASLAM.*

Having read some time ago a paper, in which it was stated by the writer that in the manufacture of German silver and brass considerable loss is sustained by the zinc becoming vapourised during the melting and cooling of the alloy, it occurred to me that the subject was deserving of further investigation, and accordingly the following somewhat interesting experiements were undertaken by me—first, to find the rate at which the zinc is vapourised by heat; and secondly, what action the other constituents, copper and nickel, exert on this vapourisation. Three specimens of commercial German silver were obtained, having the following percentage composition:—

	1.	2.	3.
Copper	53·5	50·4	56·3
Nickel	14·3	17·6	11·4
Zinc	31·8	31·2	31·9
Iron	trace		

The quantity used for experiment was in each case 2·258 grammes, and the following method was found both convenient and suitable for estimating the loss of the zinc.

The alloy was placed in a small porcelain crucible provided with a close fitting lid, through which passed two

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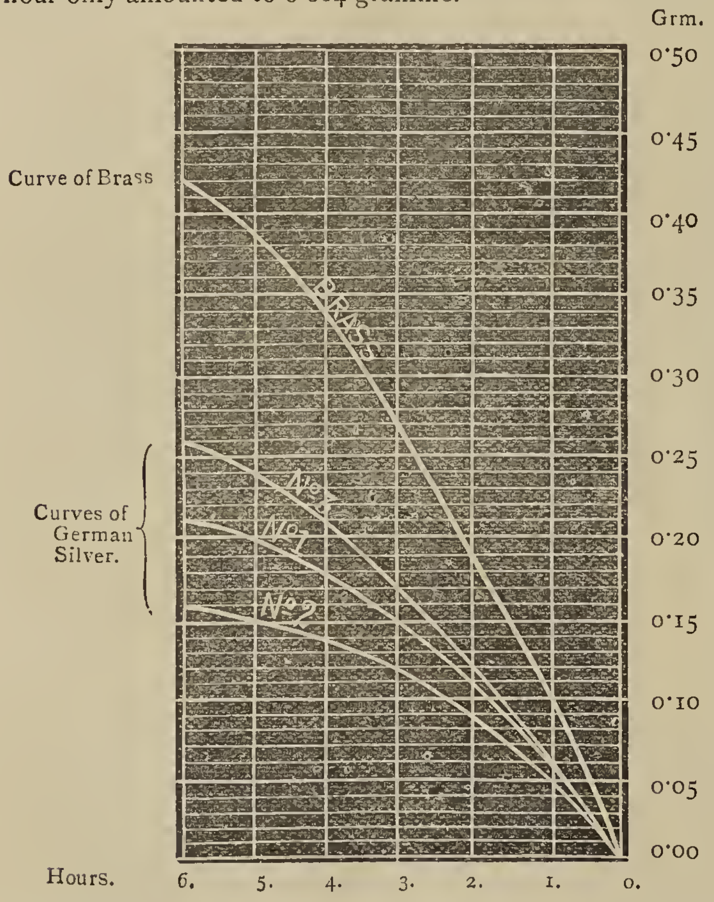
* A Paper read before the Royal Dublin Society, Nov. 17, 1884.

tubes, likewise of porcelain, so that a current of dry hydrogen could be transmitted through it and over the alloy. The crucible and its contents were then heated to bright redness in a Bunsen flame, and the alloy weighed from time to time, to ascertain the loss consequent on the evaporation of the zinc. The following table gives the results:—

Hours.	1. Loss per hour in grms.	2. Loss per hour in grms.	3. Loss per hour in grms.
1	0·056	0·050	0·058
2	0·052	0·044	0·056
3	0·045	0·034	0·050
4	0·038	0·024	0·044
5	0·026	0·016	0·037
6	0·016	0·014	0·029
Total loss	0·233	0·182	0·274

It will at once be noticed, on looking at the above Table, that the greatest amount of loss occurs in every case during the first hour of experiment. After this there is a steady decrease in the amount of zinc vapourised from the alloy. In one experiment the alloy was heated for twelve hours, and it was found that the loss sustained in the last hour only amounted to 0·004 gramme.



Curves showing Volatilisation of Zinc from German Silver Alloys.

The action of the other constituent, nickel, of the alloy is very striking. It will be observed that No. 2 alloy contains the most nickel and the least copper, and that the vapourisation of the zinc proceeds more slowly in it than in other alloys, while No. 3 contains the least nickel and most copper, and is dissociated much quicker. A specimen of brass of the same weight containing 30·6 per cent of zinc when heated for the same time gave a total loss of 0·424 grammes, or nearly double that of the German silver containing the least nickel. The curves showing graphically this action of the nickel are shown in the figure.

From these carefully obtained results I am led to conclude that German silver appears to have much more the character of a perfect alloy than brass, and that the tendency of zinc to volatilise from German silver is determined by the quantity of nickel present in the alloy, the nickel increasing the affinity of the zinc. Might not, therefore, more nickel and less copper be used with advantage in the manufacture of this important alloy?

Note added in the Press.—[Since this paper was read I have made some further experiments on an alloy of nickel and zinc, having as near as possible the composition $NiZn_2$. On heating this alloy, it was found that in six hours it had lost 0·122 gramme, or 0·060 less than the German silver alloy containing the most nickel. It was also found impossible at a bright red heat to expel all the zinc from this alloy, 9 per cent remaining constant, while in the case of brass, the percentage of zinc may be reduced as low as 1 per cent. I have not found it possible to deprive brass entirely of its zinc by heating it in a porcelain tube over a combustion furnace: from 0·6 to 1 per cent remains constant.]

PROCEEDINGS OF SOCIETIES.

CHEMICAL SOCIETY.

Ordinary Meeting, Thursday, March 5, 1885.

Dr. W. H. Perkin, F.R.S., President, in the Chair.

Mr. William Lane Clarke was formally admitted a Fellow of the Society.

Certificates were read for the first time in favour of Messrs. Frank Harris Alcock, Golden Hill, Stoke-upon-Trent; Matthew Cannon, Lavender Hill, S.W.; Martin Dechan, Hawick, N.B.; Charles Frederick Hope, Field View House, Grosvenor Terrace, York; N. H. J. Miller, Ph.D., 8, Oppidans Road, N.W.; Alexander Milne, Bombay; C. M. Stuart, M.A., High School, Newcastle, Staffordshire; William Palmer Wynne, B.Sc., 5, Honeywood Road, Harlesden, N.W.

The following were elected Fellows of the Society:—

Messrs. E. G. Amphlett, C. M. Blades, R. G. Blaine, Julius B. Cohen, F. M. Davies, E. H. Farmer, Adam Gibson, John B. Hutcheson, A. H. Knight, William Mc D. Mackey, George Patterson, F. W. Simpson, Joseph M. Stocks, Charles Watson, and Walter C. Williams.

The following papers were read:—

17. "*On the Conversion of Pelouze's Nitrosulphates into Hyponitrites and Sulphites.* By Prof. E. Divers, M.D., and Tamemasa Haga.

The nitrosulphates may be regarded as thiosulphates in which nitric oxide takes the place of sulphur; in accordance with this view, the authors find that just as thiosulphates are converted by treatment with sodium into sulphite and sulphide, so nitrosulphates become sulphite and hyponitrite; they represent the change by the equation:—$(SO_3K)(N_2O_2)K+2Na = (SO_3K)Na+Na(N_2O_2)K$, and propose to substitute the term *nitrososulphate* for nitrosulphate. The experiment was performed by digesting potassium nitrososulphate dissolved in a concentrated solution of potassium hydroxide with sodium amalgam.

Discussion.

Prof. Odling looked upon the disruptive hydrogenation of the nitrosulphates effected by the authors as a reaction of considerable interest, from its associating these salts with the thiosulphates in their mode of decomposition not less than in their mode of formation. He was disposed to think, however, that the itself put forward by the authors was the prevailing view as to the constitution of the nitrosulphates. With regard to the nature of the class of hyponitrites discovered some time back by Dr. Divers, he would suggest the possibility, at any rate, of these salts being metallic derivatives of an unstable nitramide, $NH_2.NO_2$, a body resulting from the abstraction of one unit of water for each unit of ammonia in nitrate of ammonia, the nitrile, or nitrous oxide, resulting from the abstraction of two units of water for each unit of ammonia. This suggestion as to the hyponitrites would not necessarily affect the view put forward with respect to the nitrosulphates, but would allow of their being also regarded as sulphonate-derivatives, $(KSO_3)NK.NO_2$, of the hypothetical nitramide. (In his second paper Dr. Divers himself suggests these formulæ.)

Dr. JAPP thereupon pointed out that the amides as a rule take up water, whereas hyponitrous acid very readily splits up into water and nitrous oxide. The property of readily forming anhydrides is peculiar to dibasic acids: now Zorn's experiments went far to prove that hyponitrous acid was dibasic, so that the formula HO.N.N.OH was to be preferred.

18. "*On the Constitution of some Non-Saturated Oxygenous Salts and the Reaction of Phosphorus Oxychloride with Sulphites and Nitrites.*" By Prof. E. DIVERS, M.D.

The object of the paper is to show that non-saturated oxygenous metallic salts differ from those which are saturated, not in the manner in which they are universally represented as doing, viz., in having their negative elements of lower than maximum valency, but in being less "oxylic" than the saturated salts of the same element, or in the case of salts of mon-acids not oxylic at all. Thus the author maintains that the sulphites are to be represented by formulæ such as $Ag(AgO)SO_2$, and not $(AgO)_2SO$; the nitrites by formulæ such as $AgNO_2$, not AgO.NO.

The current belief that the sulphites are dioxylic appears to rest on the fact that they are less stable than the sulphates; and on the conviction that all oxygenous salts, including sulphites, are oxylic, a conclusion which has been deduced from experiments on the action of PCl_5 and $POCl_3$. The author argues, however, that the thionyl chloride, $SOCl_2$, obtained on treating a sulphite with PCl_5, results from some secondary change. Assuming sodium sulphite to be $NaSO_2.ONa$, the transition product $NaSO_2Cl$ would be formed; this would decompose into NaCl and SO_2, and the SO_2 would react upon PCl_5, forming $SOCl_2$. It is shown that no $SOCl_2$ results from the action of $POCl_3$ on either calcium, or lead, or sodium sulphite, and therefore the argument based on the assumed production of $SOCl_2$ by means of this reagent falls to the ground. The production of chloride and phosphate together with SO_2 appears indeed to afford direct evidence of the "sulphonic" constitution of the sulphites, as the reaction appears to be—

$$3NaSO_2.ONa + POCl_3 = 3NaCl + (NaO)_3PO + 3SO_2.$$

As evidence that the sulphites are not dioxylic, the following reactions are discussed by the author:—1. The action of heat upon sulphites, whereby thiosulphate is produced (Geuther); taking into consideration the conclusive evidence there is that in thiosulphates half the sulphur occupies the place of half the oxylic oxygen in sulphates, the formation of a thiosulphate affords an unmistakeable indication that in the sulphites the metallic radicle is partly in direct union with the sulphur, as if both metal and sulphur were oxidised no mode of reaction is open by which a sulphide could be formed. The author quotes experiments showing that the production of thiosulphate is due to the reduction of sulphur dioxide to sulphur by the sulphite. 2. On addition of SO_2, or of a sulphite, to a solution of quinine in sulphuric acid, the fluorescence is destroyed. This is of importance as proving the partly non-oxylic nature of sulphurous acid, since Stokes has shown that a haloid or non-oxylic acid quenches the fluorescence of an oxylic salt of quinine. 3. Mixed sulphites of silver are readily obtained, even silver chloride being freely soluble in solutions of sulphites of alkali-metals. It is well known that silver does not enter into the composition of mixed salts of acids which are exclusively oxylic, but that such salts are readily enough prepared from the haloid acids. 4. Spring's observations on the formation of sulphite from hyposulphate, trithionate, and thiosulphate by the action of sodium amalgam, and on the synthesis of thiosulphate and trithionate from sulphite (*Chem. Soc. J.*, Abstr. xxvii., 123; xxviii., 129). 5. The conversion of sulphonates into sulphite and phenol on fusion with caustic alkali.

The relative instability of the sulphites is to be accounted for by the presence of the unoxidised metallic radicle. The oxidisability of moist or dissolved sulphur dioxide thus meets with an explanation: being partly converted into sulphurous acid of the formula $HSO_2.OH$, it therefore contains unoxidised hydrogen.

If it be admitted that the sulphites are not dioxylic, there is no evidence of sulphur being sexvalent towards oxygen. The existence of Berthelot's compound, S_2O_7, which may appear to favour the view that sulphur is not quadrivalent but sexvalent, may fairly be doubted; considering the difficulties to be encountered in preparing and analysing such a body, it is not improbable that Berthelot dealt with a mixture of SO_3 with SO_4 or S_2O_8, the initial term of the series SO_3S (probably S_4O_6), SO_3Se, SO_3Te. Sulphur dioxide, the author thinks, should be represented by a formula in which the oxygen atoms are connected rather than by the formula $O:S:O$, which latter, however, must be regarded as established by the reaction: $OSO + PCl_5 = OSCl_2 + POCl_3$, but this stands alone.

The constitution of the various thionyl and sulphonyl compounds are fully discussed by the author on the hypothesis that sulphur is quadrivalent towards oxygen. He would define a sulphonate as an organic sulphite, and suggests that the sulphurous ethers, at present called sulphites, might be termed *thionites.*

In a similar manner the author endeavours to show that the properties of the metallic nitrites do not afford any grounds for supposing that they are oxylic salts. He calls attention to the large number of metallic derivatives that are known in which the metal is in direct association with nitrogen, and to the power that nitrogen has even to displace oxygen in some metallic oxides. He states that silver nitrite is but imperfectly acted upon by phosphorus oxychloride, no oxychloride of nitrogen being among the products; and that the fluorescence is destroyed on the addition of silver nitrite to a sulphuric acid solution of quinine. He refers to Russell's experiments on the action of hydrogen on silver nitrate as of special importance and as furnishing the facts in direct support of the view that nitrites are non-oxylic. They afford proof, as nearly as possible, that silver, although it cannot separate hydrogen from oxygen, yet separates it from nitrogen, and aided by this hydrogen then also dissolves in nitric acid itself: $2Ag + HNO_2 + HO.NO_2 = 2AgNO_2 + H_2O$. Nitrites are unlike nitro-bodies because of the presence in them of unoxidised metal. The nitrous ethers are not regarded as nitrites, and their formation along with the nitro-paraffins or true nitrites is attributed to the latter undergoing change at the moment of production.

If the nitrites be regarded as non-oxylic salts, there is no evidence that nitrogen is ever quinquivalent towards oxygen; and it may be regarded as probable that in the radicle NO_2 the two oxygen atoms are associated together as well as with the nitrogen.

DISCUSSION.

Prof. ODLING regretted the impossibility of adequately discussing off-hand the many ingenious experiments and arguments set forth in the paper. The view taken by Dr. Divers as to the constitation of ordinary metallic sulphites and nitrites had before now been put forward in a casual way, earliest in point of time, he believed, by himself; but this was the first occasion of its being, after full consideration, definitely advocated on the basis of experiment and interpretation of results. He would express his own unreserved concurrence with Dr. Divers to this extent, that, judged by their properties, ordinary metallic sulphites and nitrites presented on the whole a closer analogy to the variety of organic sulphites and nitrites commonly called sulphonates and nitro-compounds, than to the other variety of organic products to which the names sulphite and nitrite were more usually restricted. That the so-called sulphonates and nitro-compounds were essentially organic sulphites and nitrites did not, in his opinion, admit of question, and he had long been in the habit of so representing them. He could not, however, go so far with Dr. Divers as to accept for a metallic sulphite or nitrite the particular conception expressed in the one, to the entire exclusion of that expressed in the other, of the constitutional formulæ under discussion. To those chemists who looked upon structural formulæ as expressing the ascertained actual constitution of bodies, the alternative use of two inconsistent structural formulæ for one and the same body was an absurdity. But to those who, like himself, looked upon structural formulæ only as condensed expressions of the reactions of the bodies formulated, there was nothing absurd in the assignment of two or more inconsistent structural formulæ to one and the same body when manifesting what seemed to be inconsistent reactions. Many instances of so-called intramolecular transformation seemed to him only instances of reactions inconsistent with the expression of the constitution of the reagent by any such single structural formula as we were at present able to devise.

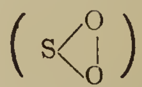
Dr. Wright said that he also preferred to use formulæ to represent particular reactions, and not as expressions of the actual constitution of bodies; he therefore saw no objection to the occasional use of inconsistent formulæ. The formulæ we were in the habit of using could not be true constitutional formulæ, for the mere reason that they represented the atoms as grouped in a single plane.

Prof. Tilden drew attention to the analogy existing between the sulphites and the carbonates; if the views of the author were admitted a very wide discussion would be opened. Isomeric sulphites should be possible, if Dr. Diver's formulæ were admissible.

Dr. Debus was inclined to question the validity of the arguments put forward by Dr. Divers; after all, such questions were very much matters of opinion. As the action of ethyl iodide on silver nitrite gave rise to two isomeric compounds, it might be held that silver nitrite was a mixture; he, indeed, thought that probably there were two kinds of nitrites.

Dr. Armstrong said that the paper was of importance, as it must serve to call attention to the many points which await discussion relating to the chemistry of elements other than carbon. But he thought that in discussing questions such as were raised by Dr. Divers we were treading upon very slippery ground; that we must recognise that it is very difficult to draw any definite conclusions regarding the "constitution" of compounds, such as are referred to, containing polyad elements, and especially associated *negative* polyad elements. We must admit that the molecules of such compounds are highly plastic; that they are characterised by great intramolecular mobility of their elements. Recent investigations have brought to light numerous remarkable cases of isomeric change among carbon compounds, and taking these into account, there can be little doubt that isomeric change will be found rampant when our methods of determining formulæ for compounds, other than those of carbon, are more advanced. Admitting the force of many of Dr. Divers's arguments, he would therefore object to go so far as Dr. Divers did, and would rather believe that in some cases the current belief, and in others that expressed by the author of the paper, was to be accepted; in other words, that all sulphites (and all nitrites) were not necessarily represented by one and the same formula. He could not agree with Prof. Odling and Dr. Wright, however, that it was permissible to assign two or more inconsistent formulæ to one and the same body. Regarding so-called constitutional formulæ as symbolic expressions of the chemical behaviour of compounds, it should be possible to devise for every compound a formula which would include all other less comprehensive expressions; our inability to do so in any case could only arise from want of knowledge of the compound, or from imperfection or incompleteness of the symbolic system. He thought that in considering these questions we are apt to take too formal a view; that we had fallen too fully under the control of constitutional formulæ; indeed, most, if not all, of Dr. Divers's arguments, might fairly be met by adversaries. Thus, assuming sulphites to be dioxylic, the action of $POCl_3$ may be represented as involving, in the first place, the formation of $NaCl$, SO_2 and P_2O_5, phosphate being then produced by the action of the P_2O_5 on an additional quantity of sulphite. In the production of thiosulphate, it might be supposed that by combination with sulphur the sulphite was converted into the compound $(NaO)_2SOS$, which then at once underwent isomeric change. With reference to the oxidisability of sulphurous acid, he had more than once before contended that SO_2 was not oxidisable and sulphurous acid was, in consequence of the latter and not the former being an electrolyte; why the one and not the other was an electrolyte was an altogether different question.

Dr. Japp said that, speaking within the limits of the doctrine of valency, he viewed with suspicion the formula—



assigned by Dr. Divers to sulphurous anhydride. This formula was a return to the devices adopted by the adherents of the dogma of constant valency when they wished to put the oxygen atoms out of court in determining the valency of polyad elements. The adherents of this view believed that the oxygen atoms in the oxides of polyad elements were capable of uniting with one another,—of practising a species of collusion, in fact, to deceive the unwary chemist,—and that their testimony was therefore untrustworthy. The *reductio ad absurdum* of the linked-oxygen view was to be found in the formulæ to which it led in the case of the perchlorates and periodates: thus potassium perchlorate would be written K—O—O—O—O—Cl, a formula which Kolbe happily compared to the result of Baron Münchausen's feat of shooting ducks with his ramrod. This mode of uniting the oxygen atoms had, on further examination, broken down in almost every case where it had been adopted,—even where, as in the case of the quinones, it had been adhered to with considerable obstinacy.

19. "*The Illuminating Power of Hydrocarbons. I. Ethane and Propane.*" By Percy F. Frankland, Ph.D., B.Sc.

In continuing his researches on illuminating gas, the author has determined the illuminating power of ethane and propane. The gases were prepared by the action of the zinc-copper couple on ethyl and isopropyl iodides respectively, and then subjected to purification by passing them through bromine. The illuminating power of ethane, when consumed from a "referee's burner," at the rate of 5 cubic feet per hour, was found to be 34·8 candles, and that of propane 53·3 candles. The illuminating power of ethane is thus almost exactly half that of ethylene (68·5 candles), whilst that of propane is 1·5 times as great as that of ethane. From these results it appears that in the paraffin series of hydrocarbons, excluding the first member, methane, the illuminating power is directly proportional to the number of carbon atoms in the molecule.

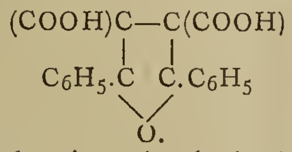
20. "*On Benzoylacetic Acid and some of its Derivatives.*" Part III. By Dr. W. H. Perkin, jun.

Ethylic dibenzoylsuccinate, obtained by treating ethylic benzoylsodacetate with iodine, crystallises from ether in needles melting at 129°. It is converted into a disodium derivative by the action of sodium ethoxide, from which apparently the sodium can be removed by means of iodine. *Dibenzoylsuccinic acid* is obtained by hydrolysis of the ethylic salt with alcoholic potash, but it is difficult to prepare.

On boiling ethylic dibenzoylacetate with dilute sulphuric acid, it is converted into an acid corresponding with Harrow's carbopyrotritaric acid,—

$$C_{22}H_{22}O_6+H_2O=C_{18}H_{12}O_5+2C_2H_6O.$$

This acid and a number of its salts are fully described. If treated with excess of acetic anhydride it loses the elements of a molecule of water, being converted in a beautifully crystalline neutral body, $C_{18}H_{10}O_4$, which may be re-converted into the acid by means of alcoholic potash. The author regards the acid $C_{18}H_{12}O_5$ as *diphenylfurfurdicarboxylic* acid,—



Ethylic benzoylsuccinate is obtained by the action of ethylic monochloracetate on ethylic benzoylsodacetate. If hydrolysed by boiling with concentrated baryta water it yields benzoic and succinic acids; but if dilute sulphuric acid be used, benzoylpropionic acid and carbon dioxide are produced.

In the same way that ethylic acetoacetate is converted on heating into dehydracetic acid, so is ethylic benzoylacetate converted in a similar manner into the corresponding *dehydrobenzoylacetic acid*,—

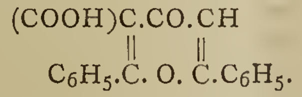
$$C_{18}H_{12}O_4 = 2C_{11}H_{12}O_3 - 2C_2H_5OH.$$

If the heating be prolonged other condensation products are obtained, two of which—formed probably from 3 and 4 mols. of the acetate by withdrawal of the elements of 3 and 4 mols. of alcohol—are described.

Dehydrobenzoylacetic acid crystallises in long yellow needles melting at 171° to 172°. It is a mon-acid; its salts, a number of which are described, are very stable. It does not combine with bromine; it is unaffected, even after prolonged heating, with acetic anhydride; but it is readily acted upon by phenylhydrazine. Ethylic dehydrobenzoyl acetate, prepared from the silver salt and ethyl iodide, crystallises from benzene in almost colourless needles melting at 159; it yields a (probably mono-) sodium derivative on treatment with sodium ethoxide.

Dehydrobenzoylacetic acid is converted into benzoylacetic acid by the action of alcoholic potash. On reduction with sodium amalgam it yields an acid of the formula $C_{18}H_{14}O_4$, together with a small quantity of another of the formula $C_{18}H_{12}O_3$, or perhaps $C_{18}H_{14}O_3$. On treatment with PCl_5 it yields a chlorinated compound, $C_{18}H_{11}ClO_3$, which is apparently a chlorinated acid of the formula $C_{17}H_{10}ClO.COOH$, and not an acid chloride.

The author fully discusses the bearing of his observations, and suggests as the most probable formula of dehydrobenzoylacetic acid the following:—



He supposes that, as in almost all cases of condensation of ethylic acetoacetate and benzoyl acetate, the molecule first undergoes an internal change, the stable molecule $C_6H_5.CO.CH_2.COOEt$ becoming the "labile" $C_6H_5.C(OH):CH.COOEt$.

(It is, I think, more probable that the condensation occurs under the influence of some minute impurity which combines with the acetate, forming a compound that may be represented as $Ph.CY(OX).CH_2.COOEt$. From this point of view it is desirable to study the action of various "condensing" agents on ethylic acetyl and benzoylacetates, as a better yield of their dehydro-products may perhaps be thus obtained.—H. E. A.)

UNIVERSITY COLLEGE, LONDON,

Chemical and Physical Society.

Thursday, March 5, 1885.

C. E. Cassal, F.I.C., F.C.S., President, in the Chair.

A "*Communication on Gas Stoves*," was read by A. E. Brown, B.Sc. The author described five forms of gas stove Lux-Calor, Lump Asbestos, Sun-dial, Fletcher, and Wilson. A modification of Fletcher's stove is made by enclosing it in a sheet-iron case and connecting with a pipe-flue. This form makes a disagreeable smell, due to the burning of organic matter in the air on the iron case. The author substitutes a thin terra cotta case for the iron one, which succeeds completely in removing the smell.

A Paper "*On the Commercial Preparation of Cyanides*" was then read by H. L. Sulman. It contained a *resumé* of the present modes of manufacture of potassic ferrocyanide in England and on the Continent. The author drew attention to the numerous improvements and fresh processes for the production of cyanides put forward from time to time, their almost universal failure when tried upon the large manufacturing scale, and the apparent difficulty of superseding the old "prussiate melting" system. Also an account of the author's endeavours to obtain cyanides as practically valuable by-products in the preparation of animal charcoal, &c., was given.

Mr. A. G. Howard exhibited a specimen of cupreïn sulphate, a salt of the new alkaloid obtained from cuprea bark.

Samuel Rideal, *Hon. Sec.*

INSTITUTE OF CHEMISTRY OF GREAT BRITAIN AND IRELAND.

The Annual General Meeting of the Institute was held in the Lecture Theatre of the Chemical Society, at Burlington House, on Monday, February 2nd, at 5 p.m. Dr. Odling, F.R.S., President, in the Chair.

The Report of the Council having been read by the Secretary, the Balance Sheet and Statement of Account for the past year was presented by the Treasurer, and the Auditors reported that they had carefully examined the books of the Institute, and found the accounts accurately balanced.

The President then delivered his Address, as follows:—

Arising out of the Report of the Council is one subject for regretful comment, which I am sure you would not like to be passed over without some notice on my part. I refer to the loss which professional chemistry has sustained by the death of our late Vice-President, Dr. Voelcker. To myself, and I have no doubt to many others, Dr. Voelcker always seemed as a type of the deservedly successful professional man. Having at the first a very uphill prospect before him, and his early steps on the way having to be taken under circumstances of no small disadvantage, he eventually succeeded by dint of industry, good faith, good judgment, and I will add good feeling, not only in building up step by step a really substantial fortune, but also in winning for himself a position of considerable eminence, professional, scientific, and social; and, together with that, the respect and regard of a wide circle of friends and associates. On various occasions it has been my lot to be associated with Dr. Voelcker, sometimes as a professional opponent, sometimes as a professional colleague. As an opponent he was not the less formidable from being always fair-minded and considerate towards those to whom he was professionally opposed; while, as a colleague, he was as strictly loyal to those with whom he was acting as he was unmistakeably useful to them, by reason alike of the carefully culled information he was sure to bring to bear on the matter in dispute, and of the general respect which had got to be entertained for his opinion.

In sequence to the foregoing remarks I would venture to enlarge for a few moments on the mutual consideration it is so desirable should subsist between members of our own body, placed temporarily in a position of professional antagonism. Among professional chemists engaged to any large extent in what may may be called forensic chemical practice, it happens not unfrequently, and sometimes with curious persistency for a considerable length of time ogether, that some two or three of those prominent in this department of applied chemistry get to be habitually opposed on almost all occasions, and on the most varied matters, to some two or three others also engaged largely in the same department of chemical work. Now it is only in the nature of things that this habitual professional opposition should not tend to increase the personal estimation which the opponents get to entertain of each other's conduct and character; and it is a fortunate circumstance when, by some happy chance, any such habitual professional antagonism is broken by a spell of professional co-operation. For it is only when we come to know a man by intimate association with him in the conduct of a common work and the pursuit of a common interest, that we become fully alive to his good qualities, —it may be different in character from our own, but which we soon learn to appreciate the value of. We unexpectedly discover much to like and respect in our former opponent, we take a more gentle view of his peculiarities, and begin to perceive that in some matters of former offence we had, in our necessary ignorance of the circumstances, taken too harsh, if not, indeed, a wholly incorrect, view of his conduct. Unhappily, in every walk of life, over-clever and not too scrupulous individuals are to be met with who do not improve upon acquaintance, and for some of whose proceedings there is little to be said in the way of excuse, or even palliation. But as among members of the same body placed temporarily in professional antagonism, the great point is for them not to be misled by their relative positions into any harsh judgments of one another, or into attributing or imagining misconduct in respect to matters of which, situated as they are, it is impossible they should know fully the real circumstances. Moreover, as between hostile chemical witnesses, it should never be forgotten that in nearly every chemical case there is much sound chemistry to be advanced in favour of both sides of the question; and that it is next to impossible for anyone to know fully the two sides, until each side has been made the most of by its respective partizans. And further even than this, it may well be borne in mind that views expressed in direct contradiction to our own views, and even statements of fact made in contradiction to our statements, however shocking, and worse than shocking, they may strike us at the moment to be, are not, impossibly, just the views and statements that we should ourselves have honestly maintained had the matter been presented to us throughout from an opposite of view; and had we ourselves known what, in their investigation, our opponents have found out; and had we been, like our opponents, ignorant of what has been exclusively made known to ourselves in the case.

I have already referred to the corrective against harsh and unfounded imputations and conceptions among forensic chemists which is afforded by the circumstance of their having to co-operate from time to time in carrying out some action in common. Happily the Institute of Chemistry affords to all professional chemists a permanent bond of union. Here they can be engaged continuously in the conduct of a common work, and be brought into that friendly and appreciative relationship with one another which results from their acting earnestly together, to effect the achievement of a common purpose.

The object for which the Institute of Chemistry has so strong a claim upon our interest is the maintenance and advancement of the position of the professional chemist; and that by means of which the worthiness and public benefit are quite beyond question, namely, by guaranteeing and raising the standard, alike of competency and conduct, among those engaged in chemical practice. Formal admission into the ranks of a learned profession, demanding on the part of its members the possession of qualifications prescribed by a recognised competent authority, is found in all cases to afford special advantages, social and material, to those so admitted. But, in return for these advantages, it imposes certain correlative obligations; but for which, indeed, it would hardly confer the standing which admission into the older professions of Divinity, Law, and Medicine, as represented by the Church, the Bar, and the College of Physicians, has long been recognised to confer. In particular, there is the obligation to observe a code—for the most part an unwritten code—of etiquette, adapted to maintain a high tone of professional conduct, and thereby to bring about a feeling of public respect for the profession in general, and a favourable predisposition towards the individual by reason of the profession to which he belongs. Putting aside extreme cases, it is difficult to formulate in words what constitutes unprofessional conduct; and it is possible that in the older professions the line condemnatory of certain practices as inconsistent with the dignity of the calling, and reflecting injuriously on its followers, may be drawn in too old-fashioned a spirit. But in all professions alike, old and new, that sort of competition which takes the form of touting for practice, of open or scarcely concealed self-advertising, of dealing in questionable certificates, and, indeed, of making irregular appeals of any kind to public patronage, are strictly and most properly discountenanced. While in all professions it is more or less difficult in the first instance for unknown men to make themselves known, there are yet, in all professions, recognised and approved modes by which the younger members can and do become known, without any resort to practices the general adoption of which would be injurious to the character of the profession, and detrimental to the best interests of its members at large.

It is hardly for the Institute of Chemistry, and certainly not as yet, to lay down any hard-and-fast rules on these matters: there are advertisements and advertisements, certificates and certificates, which have very little in common with one another. Moreover, in no case would it be advisable for the Institute, even with the hoped-for increase of its powers, to legislate in advance of the general feeling of the Fellows. Much of what is desired, and that has been felt by the Council to be desirable, must be left for the present, and it is to be hoped always, to a growing sense of common interest and mutual obligation among practising chemists as members of a corporate body, and to the development among them of a more strictly professional tone of feeling, repressive of everything which in other professions is thought to be derogatory.

The Institute has to regret the retirement of Dr. Wright from the office of Treasurer, which he has held continuously from the period of our incorporation. For some time past Dr. Wright has found that his current engagements did not allow of his attending the Meetings of Council and Committee with the regularity which he felt to be requisite, and at the last Council Meeting of the old year he tendered his resignation, which, in view of the grounds on which it was tendered, the Council had no choice but to accept, with an earnest expression of regret that they were to be deprived of his special services as Treasurer, and were to lose for a time—it was hoped for only a short time—the advantage of his aid and advice as a colleague. The Fellows are not likely to forget the altogether exceptional services rendered to the Institute by Dr. Wright in the troublous days of its early existence and gestation. He carries with him the best wishes of his old colleagues on the Council, who can only regret that the gain which they trust accrues to him from his increasing engagements should involve them in the present loss of his active co-operation with them.

Reference has been made, in the Report of the Council, to the very successful Conference which was conducted by the Institute at the International Health Exhibition. Independently, both of the interest which attached to the holding of the Conference and of the value of much that was brought forward at its sittings, the gathering has additional claims upon our remembrance, as having resulted from a formal invitation proceeding from a body appointed under a Royal Commission, and addressed to the Institute as the acknowledged representative of professional chemists. This is, I believe, the first public occasion on which the Institute of Chemistry has been officially recognised as occupying in relation to chemists the same sort of position as that occupied, for instance, by the Institution of Civil Engineers and the Institute of British Architects in relation to engineers and architects respectively.

The occasion of the Conference has been the only occasion on which the Fellows of the Institute have been called together during the past year. Throughout the year much of the time and attention of the Council has been expended in considering what should be their action in the different circumstances which have arisen, and in taking successive action, with regard to the incorporation of the Institute either by Act of Parliament or by Royal Charter. And with this important matter pending it has been thought advisable to leave other matters, financial, disciplinary, and social, also in abeyance. The position of affairs in respect to our present mode of incorporation has long been felt to be unsatisfactory. Cases have arisen in which some action of the Institute, both among its own members and in relation to external bodies, seemed to be called for, but in which it was thought that no action at all was preferable to such action, as from our present unsatisfactory status it was feared could not be exerted with effect. If by reason of the unsuitability of our present mode of incorporation to the purposes it is our object to fulfil, any public representations of our body were not likely to be made with much prospect of success, or scarcely even of attention, it was felt better that they should not be made at all.

With our application for a Royal Charter still under the consideration of the Privy Council, it is obviously unadvisable that any statement of the measures that have been taken to promote the success of our application should be put forth and considered at the present time. Suffice it that, acting under the authority of Resolutions passed at the Extraordinary General Meeting of the members of the Institute, held last year, and specially convened for the consideration of the subject, we have spared ourselves no pains, and both as individuals and as a Council have done our best in the matter entrusted to us. But there is one point in relation to our proceedings which I cannot altogether pass over, and that is the warm interest which has been displayed on our behalf by Sir Lyon Playfair, and the readiness with which he has placed his time and efforts at our disposal. We owe to him an influential representation of the nature of our aims, and of the desirability, from a public point of view, of our being accorded the power to carry them out efficiently. And if, as we have reason to hope, our application to the Privy Council should prove successful, its success will be due in no small measure to his hearty co-operation with us, and to his personal exertions in making our way smooth.

NOTICES OF BOOKS.

Photo-Micrography; including a Description of the Wet Collodion and Gelatino-Bromide Processes, with the best Methods of Mounting and Preparing Microscopic Objects for Photo-Micrography. By A. Cowley Malley, M.B., F.R.M.S. Second Edition, Revised and Enlarged. London: H. K. Lewis.

Photography, and especially what the author calls photo-micrography, are playing from year to year a more important part in scientific investigations. A series of well-executed proofs is often of more value than a collection of actual preparations, not merely for recording the results obtained, but even for their future study. Hence an acquaintance with micro-photography is of great value to the chemist and the mineralogist, not less than to the biologist. Mr. Malley has therefore done good service to science by the production of his compendious and practical treatise.

In the first two chapters we find an account of the properties of lenses, the imperfections of resulting images, aberration, and the recent improvements in objectives. With reference to angular apertures the author quotes the conclusion of Professor Abbe, that "the larger the angular aperture, the greater the quantity of diffracted rays transmitted, and the truer the resulting image as regards the actual structure of the object." He goes out of his way, however, in our opinion, in quoting the sneer of Hegels', that "the English are that nation in Europe which, like the huckster and workman class of the state, are destined to pass their lives immersed in matter." The author of this sneer was doubtless ignorant of the fact that the English, next to the Chinese, are the nation most completely immersed in and dominated by words, and that the great reform which we need is the direction of our attention, in the first place, to things.

The compound microscope is next discussed. Here the author expresses a preference, in which he is supported by not a few of the most skilful microscopists, that a mechanical stage with its milled heads is not preferable to one where the necessary motions are given by means of the fingers.

A modified form of Smith and Beck's monocular, modified for photographic purposes, is next given. The arrangements for illumination, and the camera and dark room are then described.

In the next chapter we come to the mounting and preparation of objects. Here comes a caution which beginners and amateurs will do well to remember, namely, that balsam, on account of its high refractive index and its yellow colour, should be used only when nothing else will answer. Concerning the nature of the markings of diatoms Mr. Malley points out that they are now allowed to possess no value, even as tests of the resolving power of objectives, and that the investigation of their structure has led to misapplication of talent and waste of time.

Concerning the modifications of Rutherford's microtome, the author remarks that every one of them is greatly inferior to the original.

Among photographic processes Mr. Malley selects two: the wet collodion process and Hartley's dry plate method are recommended and described in detail. His account of the manner of photographing bears the stamp of experience and close observation. The instructions here given go into those minute details which in practice are found necessary for success.

CORRESPONDENCE.

MOTIONS OF CAMPHOR.

To the Editor of the Chemical News.

Sir,—With reference to the "Note on Camphor Motions," by Mr. Casamajor (Chemical News, vol. li., p. 109), kindly allow me to state that Dr. Phipson discovered similar curious phenomena occurred with chloral hydrate, and published a note to that effect in the Chemical News for the year 1872.—I am, &c.,

C. J. Bouverie.

Analytical Laboratory, Putney, S.W.
March 7, 1885.

CHOKE-DAMP.

To the Editor of the Chemical News.

Sir,—I enclose a report from the *Standard* of March 5, 1885, in reference to the recent sad colliery explosion at Usworth, and request that you would insert the portion marked as to the value of scientific knowledge, in the

Chemical News, in the hope that it may lead to remarks from some of your numerous readers.

Although a scientific journal would be fully occupied in pointing out the nature of various misstatements so frequently occurring in the public journals (scientific or otherwise), still it is perhaps as well, when such positive details are given, to let them be tested by qualified judges.

Not wishing my name to appear, I will merely subscribe myself,—Your obedient servant,

Oxygen.

"Mr. Lindsay had previously taken the precaution of putting nails in his mouth, which he sucked, the result of which was that the carbonic acid of which the afterdamp is composed, coming into contact with the oxide of iron, carbonate of iron, which is an insoluble compound, was formed, and thus, though exposed to the chokedamp as much as his companions, this scientific knowledge materially aided Mr. Lindsay to resist the effects of the chokedamp."

CHEMICAL NOTICES FROM FOREIGN SOURCES.

Note.—All degrees of temperature are Centigrade unless otherwise expressed.

Journal für Praktische Chemie.
New Series, Vol. xxx., Parts 8 and 9.

Contributions to a Knowledge of the Disulphones: on Ethylene-diphenyl-sulphone and Ethylene-dipara-tolyl-sulphone.—R. Otto and H. Damkœhler.—The chief results of this experimental investigation are:—Ethylene-diphenol-sulphone is readily formed on R. Otto's general method for preparing sulphones from sulphinates and the halogen compounds of alcohol radicles, by heating ethylene bromide and sodium benzol-sulphinate in alcohol. Ethylene-diphenyl-sulphone in alkaline, though not in acid, liquids is readily converted by nascent hydrogen into ethylic alcohol and benzol-sulphinic acid or benzol sulphhydrate. Bromine, even under pressure, has no action upon ethylene-diphenyl-sulphone existing in water or dissolved in benzol. Chlorine, even in diffused daylight, converts it into ethylene chloride, benzol-sulphon-chloride, and chlorised benzols, with partial elimination of sulphur as sulphuryl chloride, and with formation of hydrochloric acid. In direct sunlight all the sulphur of the sulphone is eliminated as sulphuryl-chloride, with simultaneous formation of chlorised benzols. With phosphorus pentachloride a part of the sulphone remains unchanged, whilst the rest undergoes profound decomposition. By the action of dilute potassa one of the two phenyl-sulphone radicles is liberated from the ethylene-diphenyl-sulphone as a sulphine salt, and hydroxyl being substituted there is formed a compound which may be regarded as phenyl-sulphone-ethyl-alcohol. This alcohol, which may also be produced synthetically from ethylene-chlorhydrine and sodium benzol-sulphinate, possesses all the specific properties of a mono-acid alcohol. Aqueous ammonia transforms ethylene-diphenyl-sulphone into ammonium benzol-sulphinate and a secondary amine base of a not very decided basic character, which may be viewed as diethylamine in which both ethyl-radicles have been substituted by the same number of mono-phenyl-sulphonised ethyls. Ethylamine, unlike ammonia, converts ethylene-diphenyl-sulphone into an imide base,—phenyl-sulph-naphthyl-amine. Chromic acid produces with phenyl-sulphon-ethyl-alcohols, phenyl-sulphon-acetic acid. Sodium amalgam reduces the acid to acetic acid and thio phenol. Potassium sulph-hydrate forms with ethylene diphenyl-sulphone sulphuretted compounds of unknown composition. Potassium cyanide decomposes the sulphone in water in such a manner that both the phenyl-sulphone radicles are split off as sulphinate, the rest of the sulphone being converted first into ethylene cyanide, and ultimately into succinic acid. Potassium permanganate oxidises the sulphone to benzol-sulphonates, with a simultaneous formation of carbonate, oxalate, and sulphate. Sulphuric oxychloride produces sulphonic acids. Ethylene-dipara-tolyl-sulphone is quite analogous to ethylene-dipara-tolyl-sulphone.

Sugar formed from Agar-agar; a New Acid from Arabinose; and an Attempt at a Classification of the Gelatigenous Carbohydrates according to the Sugars formed from them.—R. W. Bauer.—The chief results of this investigation are a further chemical proof of the non-identity of arabinose and lactose, since on treatment with bromine and silver oxide arabinose yields arabonic acid, and lactose lactonic acid. Agar-agar contains a carbohydrate closely related to Muntz's galactine. It has not yet been obtained in a state of perfect purity. On boiling with dilute acids it is converted into lactose.

Researches from the Chemical Laboratory of Prof. Alexander Saytzeff, at Kasan.—These include memoirs by M. Lopatkin, on the action of iodallyl and zinc upon epichlorhydrine; by M. Kononowitz, on isopropyl-allyl-dimethyl-carbinol and its methyl-ether; by J. Walter, on the applications of steam in chemical laboratories; and a preliminary notice by H. Schœne on chlor-carbonyl-sulphamyl.

Journal de Pharmacie et de Chemie.
Vol. xi., February 1, 1885.

Sulpho-carbol (Orthoxyl-phenyl-sulphurous Acid, its Antizymotic and Antiseptic Properties.—F. Vigier.—This compound is a combination of phenol with sulphuric acid. The ortho-compound alone possesses well-marked antiseptic properties, the meta- and para-compounds being practically inert. It is prepared by mixing, in the cold, equal equivalents of sulphuric acid at full strength and of phenol. The excess of acid is then saturated with barium carbonate, so that the filtrate is precipitated neither by baryta water nor by sulphuric acid. It is then concentrated at a low temperature, or, preferably, in a vacuum.

Apparatus for the Determination of Urea.—A. W. Gerrard.—This paper cannot be intelligibly reproduced without the accompanying figure.

On Arsenic Trifluoride. — H. Moissan. — Already noticed.

Preparation of Tar-water.—A. Simon.—A purely pharmaceutical paper.

The Detection of the Biliary Acids.—M. Rietsch.—The substance freed from water as far as possible by evaporation in the water-bath is treated repeatedly—five or six times—with boiling alcohol at 92 per cent. The alcoholic solutions are filtered while hot, and evaporated to dryness in the water-bath. The residue is again exhausted with boiling alcohol at 92 per cent, the alcoholic solutions are filtered whilst hot, and again evaporated to dryness. The second residue is exhausted with small quantities of water, which are filtered. If we are operating upon blood the liquid remains turbid, and presents the aspect of an emulsion, even if several times returned to the filter. To the aqueous solution there is added basic lead acetate and ammonia as long as a precipitate is formed. This is first washed three times by decantation, and then once more upon the filter, taking care to use for these operations only small quantities of water. The washed precipitate is then freed from water as far as possible by means of blotting-paper, and is next exhausted with boiling alcohol at 92 per cent. The solution is filtered while hot, mixed with a little pure sodium carbonate, and evaporated to dryness. The residue is once more exhausted with boiling alcohol at 92 per cent; the alcoholic liquid is filtered while hot, and evaporated to a small bulk, forming the solution A. This solution is mixed with about ten times its bulk of ether (ether washed with water and then dried over potassium carbonate). The solution is let settle for twenty-four or forty-eight hours; the ether is decanted, and the residue is dissolved in a little water. It is filtered; the vessel and the filter are washed with water, and the aqueous liquids are evaporated to a small volume, which is called solution B. This solution is finally tested with Pettenkofer's reagent (sugar and sulphuric acid), which gives a splendid violet colour if biliary acids are present.

Presence of Toxic Alkaloids in Urine, and in certain Pathological Liquids.—MM. R. Lépine and Guérin.—The researches of the authors show that the toxicity of the alkaloids differs qualitatively and quantitatively, according to the cases. They prove also that all the liquid extracts of a corpse do not necessarily contain poisonous alkaloids.

On Homoquinine and the Alkaloids of the so-called "Cuprea" Bark.—B. H. Paul and A. J. Cownley.—From the *Pharmaceutical Journal*.

Polymorphism of Silica Phosphate.—P. Hautefeuille and J. Margotet.

Fluoric Apatites.—A. Ditte.

On Hydrated Neutral Alumina Sulphate. — P. Marguerite-Delacharlonny.

Researches on Saccharogenesis in the Beet-root.—Aimé Girard.

The Chemical Composition and the Food-value of Different Parts of the Grain of Wheat. — Aimé Girard.

On certain Colloidal Substances.—E. Grimaux.

The Presence of Biliary Salts in the Blood of Cholera Patients, and on the Existence of a Poisonous Alkaloid in their Excreta.—G. Pouchet.

These seven papers are taken from the *Comptes Rendus*, and have all been duly noticed.

Synthesis of Piperidine.—A. Ladenburg.—From the *Berichte d. Deutsch. Chem. Gesellschaft*.

On Hyoscine.—A. Ladenburg and C. F. Roth.—Also from the *Berichte* above mentioned.

MISCELLANEOUS.

Separation of Cerium from Thorium.—M. Lecoq de Boisbaudran effects this separation by boiling the sulphates or chlorides, acidulated with hydrochloric acid, with pure copper turnings. The cerium is thus reduced. After some minutes boiling cuprous oxide is added, prepared by reducing the tartrate with glucose and potassium hydrate, and the boiling continued for one hour. The precipitated thorina is filtered and washed with water previously boiled to expel oxygen. It is dissolved in hydrochloric acid, and the copper separated by sulphuretted hydrogen or by ammonia. To effect a complete separation the operation is repeated several times.

NOTES AND QUERIES.

*** Our Notes and Queries column was opened for the purpose of giving and obtaining information likely to be of use to our readers generally. We cannot undertake to let this column be the means of transmitting merely private information, or such trade notices as should legitimately come in the advertising columns.

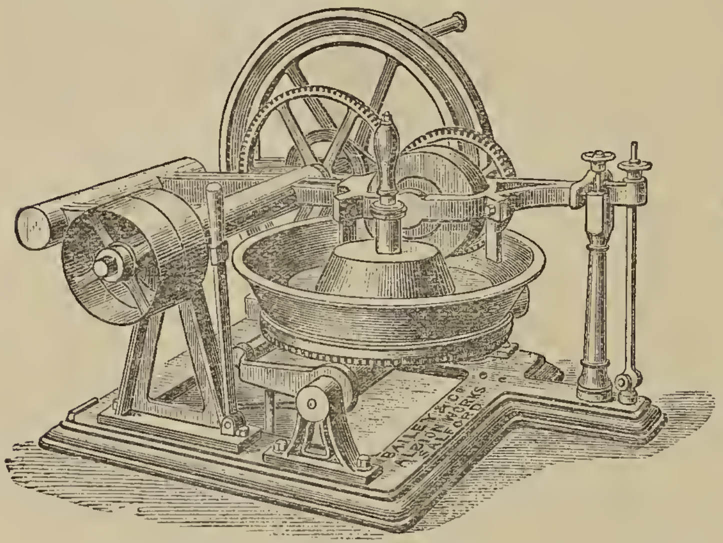
Detection of False Coins.—Having recently had occasion to test two bad half-crowns, many of which are now in circulation, and having found them to consist of tin hardened with antimony and lead, I have concluded that they must usually be made of some such composition. In this case—and indeed of whatever common alloy they are made—a spot of silver nitrate solution placed upon the coin with a glass rod will at once condemn it by producing a black stain of metallic silver. The copper in ordinary silver being insufficient to produce this effect, this method of testing silver coin could be readily applied by the inexperienced, a solution of lunar caustic and a glass rod being kept handy, just as the jeweller keeps his bottle of aqua fortis.—A Loser of Half-a-Crown.

MEETINGS FOR THE WEEK

Saturday, 14th.—Physical, 3. Discussion on Profs. Ayrton and Perry's paper on "The Most Economic Potential Difference to Employ for Incandescent Lamps." Further Lecture Experiments on Spectrum Analysis," by C. Cleminshaw.
Monday, 16th.—Medical, 8.30.
—— London Institution, 5.
—— Society of Arts, 8 (Cantor Lectures.) "Carving and Furniture," by J. Hungerford Pollen.
Tuesday, 17th.—Royal Institution, 3. "Digestion and Nutrition,' by Prof. Gamgee.
—— Institution of Civil Engineers, 8.
—— Pathological, 8.30.
—— Society of Arts, 8. "The Congo and the Conference, in reference to Commercial Geography," by Commander Cameron, R.N.
Wednesday, 18th.—Society of Arts, 8. "The Rivers' Pollution Bill," by J. W. Willis-Bund.
Thursday, 19th.—London Institution, 5 and 7.
—— Royal, 4.30.
—— Royal Institution, 3. "The New Chemistry," by Prof. Dewar.
—— Philosophical Club, 6.30.
—— Chemical, 8.
—— University College Chemical and Physical Society. "The Electric Strength of Air," Dr. A. H. Fison. "Zinc Ethyl Reactions," Mr. A. G. Green.
Friday, 20th.—Royal Institution, 8. "Liquid Films," Prof. A. W. Rücker, at 9.
Saturday, 21st.—Royal Institution, 3. "Richard Wagner," by Mr. C. Armbruster.

TO CORRESPONDENTS.

Owen.—No sulphide is formed.



THE CHEMICAL NEWS.

VOL. LI. No. 1321.

EUTEXIA.[*]

By THOMAS TURNER, Assoc. R.S.M., F.C.S.,
Demonstrator of Chemistry, Mason College.

THERE are a number of interesting facts, some of which are known to most persons, and many of them have been long recognised, of which, however, it must be owned that the explanation is somewhat obscure, and the connections existing between them have been but recently pointed out. As an example of this, it is well known that salt water freezes at a lower temperature than fresh water, and hence sea-water may be quite liquid, while rivers and ponds are covered with ice. Again, it is noticed that mixtures of salts often have a fusing-point lower than that of either of the constituent salts, and of this fact we often take advantage in fluxing operations. Further, it is well known that certain alloys can be prepared the melting-points of which are lower than the melting-point of either of the constituent metals alone. Thus, while potassium melts at 62·5° C., and sodium at about 98°, an alloy of these metals is fluid at ordinary temperatures, and fusible metal melts below the temperature of boiling water, or more than 110° lower than the melting-point of tin, the most fusible of the three metals which enter into the composition of this alloy. But though these and many similar facts have been long known, it is but recently, owing largely to the labours of Dr. Guthrie, that fresh truths have been brought to light, and a connection shown to exist throughout the whole which was previously unseen, though we have still to acknowledge that at present there is much at the root of the matter which is but imperfectly understood. Still Dr. Guthrie proves a relationship to exist between the several facts we have previously mentioned, and also between a number of other phenomena which at first sight appear to be equally isolated and unexpected, and we are asked to regard them all as examples of what he has called "Eutexia."

We may define a eutectic substance as a body composed of two or more constituents, which constituents are in such proportion to one another as to give to the resultant compound body a minimum temperature of liquefaction—that is, a lower temperature of liquefaction than that given by any other proportion.[†] It will be seen at once by this definition that the temperature of liquefaction of a eutectic substance is lower than the temperature of liquefaction of either or any of the constituents of the mixture. And, further, it is plain that those substances only can be eutectic which we can obtain both as liquid and solid, and hence the property of eutexia is closely connected with solution.

Following in the natural divisions adopted by Dr. Guthrie, we may consider eutexia in three aspects:—

I. *Cryohydrates.*[‡]

If a *dilute* aqueous saline solution be taken at ordinary temperatures, and then slowly cooled to some point below zero on the centigrade scale, the following series of changes will in general be observed:—On reaching a point below zero, the position of which is dependent upon the nature of the salt and the amount of dilution, it will be found that ice is formed: this will float upon the surface of the solution, and may be readily removed. If the ice so removed be afterwards pressed, or carefully drained, it will be found to consist of nearly pure water, the liquid draining away being a strong saline solution which had become mechanically entangled among the crystals of ice during solidification. If we further cool the brine which remains, we notice a tolerably uniform fall of temperature with accompanying formation of ice. But at length a point is reached at which the temperature ceases to fall until the whole of the remaining mother-liquor has solidified, with the production of a compound called a cryohydrate, which possesses physical properties different from those of either the ice or the salt from which it is formed.

If, on the other hand, we commence with a *saturated* saline solution, in general it is noticed that on cooling the liquid a separation of salt ensues, which salt sinks to the bottom of the mass, and may be removed. The salt so separating may be either anhydrous or a "hydrate" of greater concentration than the mother-liquor. So long as this separation proceeds the temperature falls, but at length a point is reached at which the thermometer remains stationary until the whole is solidified, with the production of a cryohydrate. This temperature of solidification is the same whether we start with a dilute or a saturated solution, and the composition of the cryohydrate is found to be constant. The temperature of production of the cryohydrate is identical with the lowest temperature which can be produced on employing a mixture of ice and the salt as a freezing mixture or cryogen.

It will be readily seen that in the formation of a cryohydrate we have an example of eutexia, since the constituents are present in such proportion as to give to the resultant compound body a minimum temperature of liquefaction.

II. *Eutectic Salt Alloys.*[*]

Although it has been long known that on mixing certain salts the resulting substance possessed a lower melting-point than either of the constituent salts alone, still but few determinations of the melting-points of mixtures of salts have been made, and even these are often of small value, on account of the very considerable range of temperature observed during solidification. This is due largely to the fact that eutectic mixtures were not known, as equivalent proportions of various salts have been employed, while eutectic mixtures are seldom found to possess any simple arithmetical molecular relationship between their constituents.

Eutectic salt alloys closely resemble cryohydrates in behaviour. If for simplicity we confine our attention to a fused mixture of two salts in any proportion other than eutectic, it is found that, on cooling, the thermometer falls steadily until at length that salt which is in excess of the proportion required for a eutectic mixture begins to separate out. If this is removed, the thermometer falls until a fixed point is reached at which the temperature remains stationary until the whole of the mixture solidifies. On re-melting, the temperature of solidification is found to be quite fixed, and the mixture is evidently eutectic.

It is of interest to notice that from our knowledge of the cryohydrates it becomes possible to predict the existence, composition, and temperature of solidification of a eutectic alloy, if we are previously furnished with the melting-points of mixtures of the substances in question. Or, in other cases, we may predict from the curve of melting-points that no eutectic alloy is possible.

As an example, we may take the determinations of the melting-points of mixtures of potassium and sodium nitrate by M. Maumené.[†] These are graphically represented in Fig. 1, the curve being derived from the mean of the temperatures given in the memoir. From this diagram we should be led to expect a eutectic mixture, since the curve dips below a horizontal line passing through the

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[*] Read before the Birmingham Philosophical Society, January 22, 1885.

[†] Guthrie, *Phil. Mag.* [5], xvii., p. 462.

[‡] Guthrie, *Phil. Mag.*, 4th Series, xlix., pp. 1, 206, 266; 5th Series, i., pp. 49, 354, 446, vi., p. 35.

[*] F. Guthrie, *Phil. Mag.* [5], xvii., p. 469; F. B. Guthrie, *Journ. Chem. Soc.*, 1885, p. 94.

[†] *Comptes Rendus*, 1883, 2, p. 45.

melting-point of the more fusible of its constituents. From our curve we should expect a eutectic mixture with about 35 per cent KNO_3, and with a temperature of solidification below 233°. Dr. Guthrie gives 32·9 per cent at 215°. This agreement is as good as might be expected when one remembers that the melting-points, not being of eutectic mixtures, are difficult to determine, and a considerable range is given; that analyses of mixtures of potassium and sodium salts are apt to vary; and that the two observers differ by ± 7° in the temperatures given for the melting-points of the original salts.

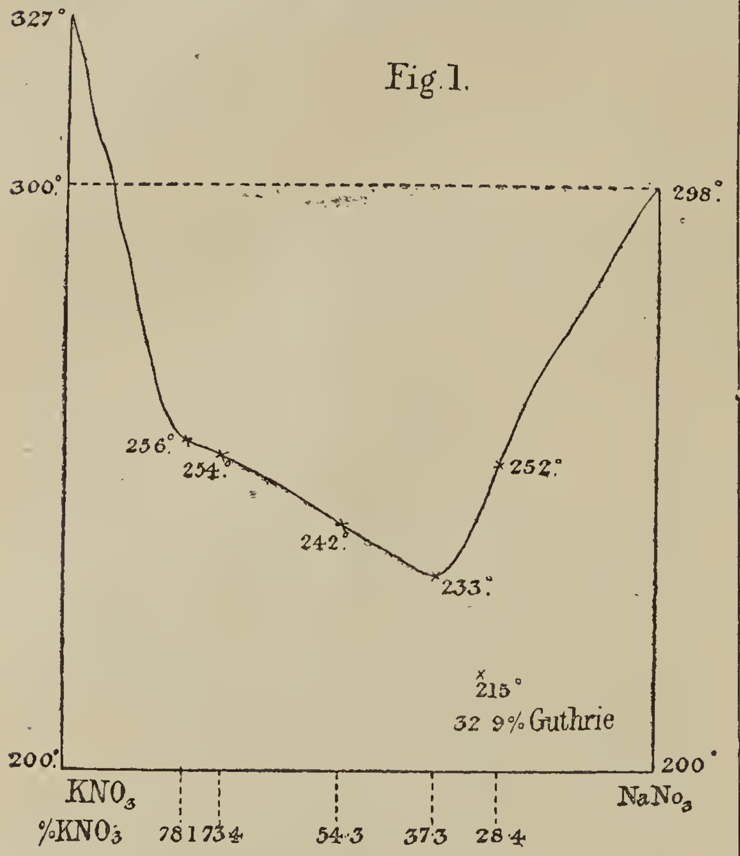


Fig. 1.

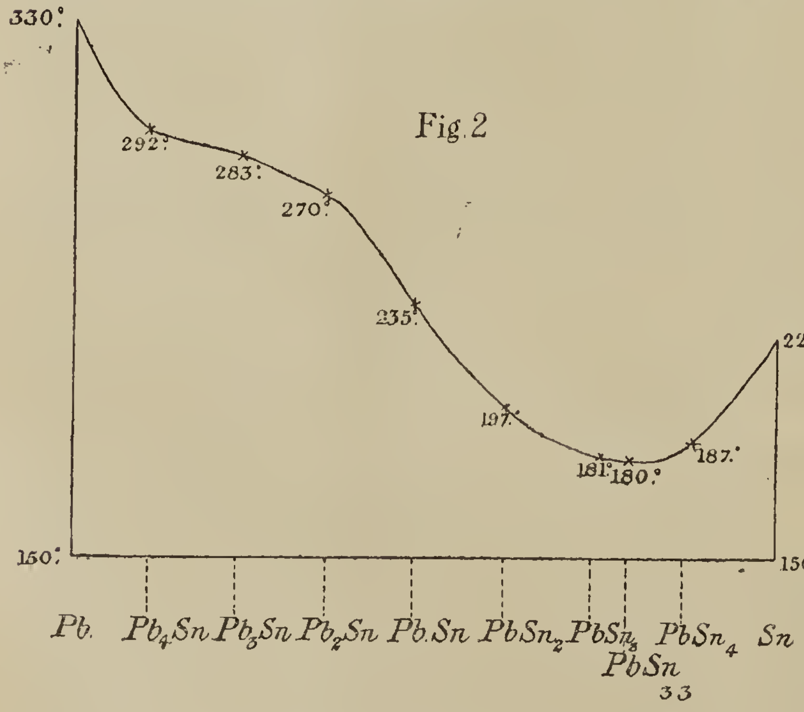


Fig. 2

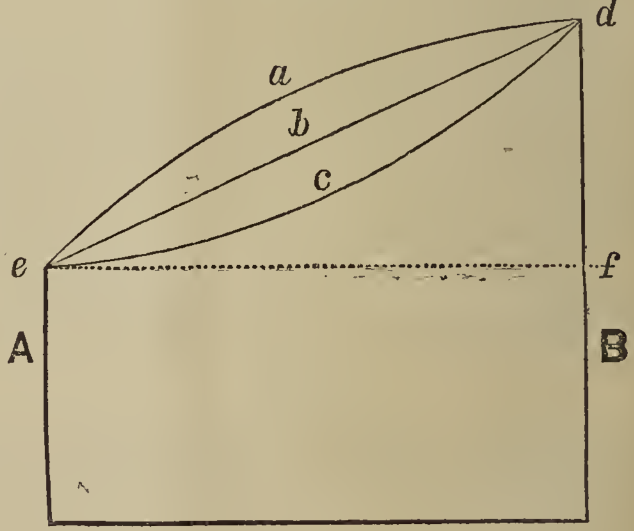
Dr. Tilden has drawn my attention to an interesting example of the lowering of melting-point by the mixture of salts. The melting-point of monohydrochloride of turpentine oil is 125°, while that of the dihydrochloride is 50°; but on simply stirring together these compounds in a mortar at common temperatures they immediately liquefy. Two molecules of the monohydrochloride and one molecule of the dihydrochloride form a mixture which melts at about 20°.

III: *Eutectic Metallic Alloys.*

Although many fusible alloys have been long known, I believe no true eutectic metallic alloy had been studied until Dr. Guthrie* worked at the subject, employing the same methods as with his cryohydrates. It is found if two metals are fused together and the mixture allowed to cool, that the temperature falls until a point is reached at which that metal which is present in a proportion greater than is required to form the eutectic alloy begins to separate. If this solid be removed as it forms, the temperature gradually falls until a fixed point is reached, at which the eutectic alloy solidifies. Here the thermometer remains stationary until the whole has become solid, and, on re-melting, this temperature is found to be quite fixed. In addition to the di-eutectic alloys, we have also tri- and tetra-eutectic alloys, and as an example of the latter we may take the bismuth-tin-lead-cadmium eutectic alloy melting at 71°.

We have already seen with salt eutectics that, given the curve of melting-points of a mixture in various proportions, we may predict the existence, composition, and melting-point of the eutectic alloy. As a matter of course, the same thing holds good for metallic eutectics. An interesting example of this is furnished by the tin-lead alloys, the melting-points of which have been determined by Pillichody.† From these determinations we obtain the curve given in Fig. 2, and from this curve, since it dips below a horizontal line passing through the melting-point of the more fusible constituent, we are at once able to predict a eutectic alloy. We should further expect this to have a constitution between $PbSn_3$ and $PbSn_4$ and a melting-point somewhat below 181°. On melting together tin and lead, and allowing the alloy to cool, we find our expectation justified; for by pouring off the fluid portion which remains after solidification has commenced, and repeating this several times with the portion so removed, we at length obtain an alloy which solidifies at the constant temperature of 180°, when the melting-point of tin is taken as 228°. On analysis 1·064 grms. of this alloy gave 0 885 grm. SnO_2, which corresponds to Sn 65·43 per cent, or $PbSn_{3\cdot3}$. This, therefore, is the composition of the eutectic alloy, and it finds its place naturally on the curve given in Fig. 2.

Fig. 3.



It will be seen that the subject of eutexia embraces many points of practical importance and of theoretical

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* *Phil. Mag.*, 5th Series, xvii., p. 462.

† *Dingler's Polyt. Journ.*, 162, p. 217; *Jahresberichte*, 1861, p. 279.

interest. Thus it has been shown by Dr. Guthrie that the desilverising of lead in Pattinson's process is but a case of eutexia, the separation of lead on cooling a bath of argentiferous lead poor in silver being analogous to the separation of ice from a salt solution. Dr. Guthrie has also shown that eutexia may reasonably be supposed to have played an important part in the production and separation of many rock-forming minerals.

It is with considerable diffidence that I suggest the following as an explanation of the multitude of facts to which previous reference has been made.

In a mixture of two substances, A and B, we have the following forces active tending to produce solidification:—

1. The cohesion between the particles of A:
2. The cohesion between the particles of B.
3. The cohesion between the particles of A and the particles of B.

With regard to this last factor it will be seen that there are three cases possible:—

1. The cohesion of the mixture A B may be greater than the cohesion of A + the cohesion of B.
2. The cohesion of A B may be equal to the cohesion of A + the cohesion of B.
3. The cohesion of A B may be less than the cohesion of A + the cohesion of B.

Now since cohesion tends to produce solidification, we should in the first case expect to find the melting-point of the mixture *higher* than the mean of the melting-points of its constituents, or the curve of melting-points would be of the form given in *a*, Fig. 3. Here no eutectic mixture is possible.

In the second case, where cohesion A B = cohesion A + B, we should obtain melting-points for the mixture which would agree with the mean of the melting-points of the constituents, the curve of melting-points would be a straight line, and again no eutectic mixture would be possible.

In the third case, however, where cohesion A B is less than cohesion A + B, we should find the melting-points of the mixture lower than the mean of the melting-points of its constituents, and the curve of melting-points would be of the form given in *e*, Fig. 3. Here, in those cases where the difference of cohesion on mixture is considerable, the curve of melting-points may dip below the line *e f*. This is the *only case* in which a eutectic mixture is possible, and it is, of course, found at the lowest point of the curve.

If it be true, as above suggested, that the force of cohesion is at its minimum in the eutectic alloy, we should expect to find, in preparing a eutectic substance, either that actual expansion took place, or that the molecular volume would gradually increase in passing along our curve of melting-points, from either end, for each molecule added, and that it would obtain its greatest value at the point corresponding to the eutectic alloy.

Of this I have no direct evidence as yet, but it is a point of considerable interest, and I may possibly return to it at some future time.

On the Pyrosulphates.—Hans Schulze.—Sulphuric anhydride combines readily with potassium sulphate even at common temperatures, the formation of the poly-sulphate being attended with a brisk reaction and the liberation of heat. Sodium, ammonium, silver, and thallium sulphates, as well as many other normal sulphates, take up sulphuric anhydride with similar energy. The sulphates are saturated with the anhydride in small retorts, and then freed from any excess of the anhydride by heating on a sand-bath to 100° to 120°. The product obtained with potassium sulphate contained 62·48 to 62·77 per cent of SO_3, and was therefore almost a pure poly-sulphate. Barium, strontium, calcium, magnesium, zinc, and lead sulphates are also capable of taking up sulphuric anhydride, though the preparation of pure poly-sulphates is not practicable with all metals.—*Chemiker Zeitung.*

THE ABSORPTION SPECTRA OF THE ALKALOIDS.

Part II.*

By W. N. Hartley, F.R.S.,
Professor of Chemistry, Royal College of Science, Dublin.

Having lately completed an examination of a series of aconitines from different sources, kindly sent to me by Dr. Stevenson, Lecturer on Chemistry and Medical Jurisprudence at Guy's Hospital, London, I beg leave to offer the results to the Royal Society.

The list of specimens, which was accompanied by remarks upon them, is the following:—

No. 1. "Exotic aconitine, probably German, rather nert."

No. 2. "A fine specimen of crystallised aconitine special, prepared by T. Morson and Son, 124, Southampton Row, London."

No. 3. "Aconitine, from Burgoyne, Burbidges, and Co., 16, Coleman Street, London."

No. 4. "Nitrate of aconitine." (This specimen was accidentally destroyed.)

No. 5. "Aconitine of uncertain source."

Of these specimens only two, namely, No. 2 and No. 3, were found to exhibit absorption-bands, and the corresponding curves were drawn from photographs of their spectra.

Morson's fine specimen, the crystals of which were one and even two millimetres in length, was found to absorb the rays at two points, the two absorptions being equally strong. It is noticeable that the most active aconitines appear to be those with the strongest absorption-bands, and of the commercial samples scarcely two yield the same absorption-spectra. The variations in the curves indicate that not only may there be considerable differences in their composition, but also in their chemical constitution.

Having prepared some of the tertiary bases in a state of great purity, it was considered desirable to examine the spectra transmitted by pyridine, piperidine, quinoline, tetra-hydroquinoline, and quinoline hydrochloride. It was found that the addition of six atoms of hydrogen to pyridine, and four atoms of hydrogen to quinoline, caused the products to become more diactinic. Hex-hydro-pyridine, otherwise piperidine, shows no absorption-band, as was predicted. Quinoline hydrochloride yields a spectrum differing from that of the base. Substitution products are less diactinic than the simple bases.

As a study of these and similar bodies promises to lead to conclusions apart from such as are of importance in this investigation, and of interest in themselves, a detailed account will be reserved for the present.

The position of the absorption-bands occurring in the spectra transmitted by these tertiary bases may be stated in the following manner:—

		Measurements of absorption-bands in wave-lengths.
Pyridine.	Band between	2700 and 2300
	With less subst., between	2570 and 2400
Quinoline.		
Two bands (1)	Between	3085 and 3039
	With less subst., between	3078 and 3039
(2)	Between	3170 and 2600
	With less subst., between	2980 and 2830
Tetra-hydroquinoline.		
Two bands (1)	Between	3180 and 2750
	With less subst., between	3180 and 2870
(2)	Between	2700 and 2300
	With less subst., between	2650 and 2370
Quinoline Hydrochloride.		
Two bands (1)	Between	3180 and 2750
	With less subst., between	3180 and 2870
(2)	Between	2700 and 2300
	With less subst., between	2650 and 2370

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* Abstract of a Paper read before the Royal Society, March 12, 1885.

Substances such as any of the natural alkaloids, which may be derived from dihydroquinoline or tetra-hydroquinoline, by replacement of the hydrogens by other elements or radicals, in such a manner as to leave the nucleus of the compound unchanged, must be expected to exhibit absorption-bands.

It now appears highly probable—

1. That morphia and some other of the opium bases are derived from pyridine.
2. That strychnine is a derivative of pyridine.
3. That brucine is a derivative of tetra-hydroquinoline, or an addition product of quinoline of the same character, since there is a remarkable similarity between the absorption curves of the two first-named substances.

I cannot close this paper without acknowledging indebtedness to the great skill and care my assistant, Mr. W. R. Barnett, has bestowed on these later observations.

ERYTHROXYLON.*

COCA.

The condition of the principal markets of the world for this drug has recently been exceptionally bad. That is, whether good coca was sought for in the ports of Central and South America, or in London, Hamburg, or New York, the search, even without limitation in price, was almost invariably unsuccessful. Not that the drug, independent of quality, was scarce, for hundreds of bales were accessible at all times, but the quality was so poor as to be quite unfit for use. The samples, instead of being green and fragrant, were brown and odourless, or musty and disagreeable, at once condemning the lots they represented, to the most casual observation, and yet the price was high enough to have represented a good article. The best that could be done by the most careful buyers was to accept occasional parcels, the best of which were of very inferior quality, and therefore unfit for medicinal uses, and these at very high prices. Coca is well known to be a very sensitive and perishable drug, only fit for its somewhat equivocal uses when fresh and green, and well cared for in packing and transportation. Very much like tea in this and other respects, it should be packed and transported with the same care and pains, in leaded chests, or in some equivalent package. It is very well known that tea, if managed, transported, handled, and sold as coca is, would be nearly or quite worthless, and therefore coca managed as the great mass of it is, must be nearly all of it comparatively worthless. If used as tea is, this would probably soon appear, but when used as a medicine which has been highly extolled and well advertised, it seems to go on equally well whether of good or bad quality. It is pretty safe to say that nineteen-twentieths of the coca seen in this market within the past two years must be almost inert and valueless, yet all is sold and used, and its reputation as a therapeutic agent is pretty well kept up. At least many thousands of pounds of the brown ill-smelling leaf, and of preparations made from it, are annually sold. And worse than this, considerable quantities of a handsome looking green leaf, well put up and well taken care of, have been sold and used as coca, when wanting in nearly all its characteristics.

The writer for more than a year past has seen but one or two small lots of moderately good coca, and in common with other buyers has been obliged to buy the best that could be found to keep up his supply of the fluid extract. Almost every purchase has been made on mental protest, and he has been ashamed of every pound of fluid extract sent out, from the knowledge that it was of poor quality; and there seems to be no more prospect of a supply of better quality than there was this time last year, because so long as an inferior quality sells in such enormous quantities at good prices the demands of trade are satisfied.

Under this condition of the markets the writer has finally decided to give up making a fluid extract of coca, and has left it off his list, adopting a fluid extract of tea instead, as a superior substitute, for those who may choose to use it, and regrets that this course was not taken a year ago.

The character of coca as a therapeutic agent is not very good. The florid stories of a multitude of travellers and writers, up to and including the testimony of Dr. Mantegazza, received a considerable support from so good an authority as Sir Robert Christison, who reported very definite results from trials made upon himself, and upon several students under his immediate control and observation; and his results seem to have led to a very careful and exhaustive series of observations at University College, London, by Mr. Dowdeswell. This paper, published in *The Lancet* of April 29th and May 6th, 1876, pp. 631 and 664, is entitled "The Coca Leaf, Observations on the Poperties and Action of the Leaf of the Coca Plant (Erythroxylon Coca), made in the Physiological Laboratory of University College, by G. F. Dowdeswell, B.A." The results of these investigations were absolutely negative, and at the close of the work the investigator says: "Without asserting that it is positively inert, it is concluded from these experiments that its action is so slight as to preclude the idea of its having any value either therapeutically or popularly; and it is the belief of the writer, from observation upon the effect on the pulse, &c., of tea, milk-and-water, and even plain water, hot, tepid, and cold, that such things may, at slightly different temperatures, produce a more decided effect than even large doses of coca, if taken at about the temperature of the body."

Conflicting and contradictory testimony from competent authority is not uncommon in therapeutics, and the reasons for it are well recognised in the impossibility of an equality in the conditions and circumstances of the investigations, and hence the general decision commonly reached is upon the principle of averages.

There can hardly be a reasonable doubt that coca, in common with tea and coffee and other similar articles, has a refreshing, recuperative, and sustaining effect upon human beings, and when well cultivated, well cured, and well preserved, so as to reach its uses of good quality and in good condition, it is at least equal to good tea, and available for important therapeutic uses. Mr. Dowdeswell supposed that he used good coca, but it is very easy to see that with any amount of care and pains he may have been mistaken in this. Had he but used the same parcel of coca that Sir Robert Christison did, the results of the two observers would be absolutely incomprehensible; and the results, in the absence of any testimony on that point simply prove that the two observers were using a different article, though under the same name, and possibly with the same care in selection. On Sir Robert Christison's side of the question there are many competent observers whose testimony is spread over many years; while on Mr. Dowdeswell's side there are fewer observers. But there has been no observer on either side whose researches have been anything like so thorough, so extended, or so accurate as those of Mr. Dowdeswell. Indeed, no other account has been met with wherein the modern methods of precision have been applied to the question at all; the other testimony being all rather loose and indefinite, often at second or third hands, or from the narratives or more or less enthusiastic travellers. But if Mr. Dowdeswell's results be accepted as being conclusive, the annual consumption of 40,000,000 of pounds of coca at a cost of 10,000,000 dollars, promotes this substance to take rank among the large economic blunders of the age.*

The testimony in regard to the effects of tea, coffee,

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* From "An Ephemeris of Materia Medica, Pharmacy, Therapeutics, and Collateral Information." By Edward R. Squibb, M.D., Edward H. Squibb, S.B., M D., and Charles F. Squibb, A.B.

* An excellent summing up of the character and history of coca, from which some of the writer's information has been obtained, will be found in "Medicinal Plants," by Bentley and Trimen vol. i., article 40.

Paraguay tea, Guarana and Kola nuts is all of a similar character to that upon coca. Each of these substances seems to have come into use independently, in widely separated countries, to produce the same effects, namely, to refresh, renew, or sustain the physical and mental organism, and it was a curious surprise to find, after they had all been thus long used, that although each came from a different natural order of plants, the same active principle,—namely, caffeine—could be extracted in different proportions from all. It is now still more curious, however, to find that for centuries another plant, namely coca, yielding a different principle, has been in use for similar purposes, the effects of which differ as little from those of tea, coffee, &c., as these do among themselves. Yet cocaine is chemically very different from caffeine, simply producing a similar physiological effect in much smaller doses. All these substances in their natural condition seem to be identical in their general physiological effect, but idiosyncrasy, or different individual impressibility or sensitiveness, causes a different action, as well in quality as in degree from the different substances, upon some persons.

In order to try to throw a little additional light on the comparative activity of the principal individuals of this group of substances, the following trials were made. It is generally admitted, and is probably true, that the same power in these agents which refreshes, recuperates, and sustains in the condition which needs or requires such effects, also counteracts the tendency to sleep,—or produces wakefulness when a tendency to sleep exists, and therefore, if a tendency or disposition to sleep could be prevented by these agents, this tendency might be used as a measure of their effects when used in varying quantities, and thus measure the agents against each other for dose or quantitative effect. In this way the proposition is to first measure coca against tea, then coffee against guarana, and finally to compare the four agents, using pure caffeine as a kind of standard to measure by.

An opportunity for such trials occurred in a healthy individual sixty-five years old, not habituated to the use of either tea, coffee, tobacco, or any other narcotic substances, of good physical condition and regular habits, and not very susceptible or sensitive to the action of nervines or so-called anti-spasmodics. Quantities of preparations of valerian, asafœtida, compound spirit of ether, &c., which would yield a prompt effect upon many individuals, seem to have little or no effect upon him, nor do moderate quantities of wines or spirits stimulate him. That is to say, he has not a very impressible nervous organisation, is not imaginative, nor very liable to accept results on insufficient or partial evidence.

Fully occupied with work, both physical and mental in due proportion, for more than ten hours every secular day, when evening comes he finds himself unable to read long on account of a drowsiness supposed to be of a purely physiological character. With a full breakfast at about 7.30, a full dinner at about 2.30, and a light evening meal about 7, and no stimulants or tea or coffee at any time, he finds, as a matter of not invariable but general habit, that by half-past 8 drowsiness becomes so dominant that it becomes almost impossible, and generally impracticable, to avoid falling asleep in his chair while attempting to read, even though ordinary conversation be carried on around him.

The first trial to combat or prevent this drowsiness was made with caffeine. The first specimen used was a very beautiful article made by Merck of Darmstadt, and after that by pure specimens made for the purpose, the two kinds being found identical in effect.

Commencing with a one grain dose at about 6.30 p.m., on alternate evenings, leaving the intermediate evenings in order to be sure that the nightly tendency still persisted, —and increasing by half a grain each alternate evening, no very definite effect was perceived, until the dose reached 2½ grains, and this dose simply rendered the tendency to sleep resistible by effort. After an interval of three evenings, with the tendency to sleep recurring with somewhat varying force each evening, a dose of 3 grains was taken,—the maximum single dose of the German Pharmacopœia. This gave a comfortable evening of restedness, without sleep or any very strong tendency to it until ten o'clock. Without anything to counteract sleep, the rule was to read with difficulty by nine, without much comprehension by quarter-past nine, and either be asleep or go to bed by half-past nine. The 3 grain dose of caffeine repeatedly obviated all this discomfort up to ten o'clock, but did not prevent the habitual, prompt, and sound sleep, from the time of going to bed till morning.

This was the model established, upon and by which to measure all the other agents, and they were never taken nearer than on alternate evenings, with occasional longer intervals, especially when the final doses of record were to be taken.

The next agent tried in precisely this same way was coca, and knowing that the quality of that which was attainable was very low, the commencing dose of the leaf in substance was 2 drachms, or about 8 grammes. This gave no very definite effect, but 2½ drachms did give a definite effect, and a subsequent dose of 2½ fluidrachms of a well made fluid extract of coca gave about the same effect as 2½ grains of caffeine. Three fluidrachms of the fluid extract were about equivalent to 3 grains of caffeine.

Both the coca used and the fluid extract were then assayed by the modern methods, for the proportion of the alkaloid they contained.

The only assays of coca that could be found conveniently were those of Dr. Albert Niemann, of Goslar, given in the *American Journal of Pharmacy*, vol xxxiii., p. 122, who obtained 0·25 per cent; and of Prof. Jno. M. Maisch, in the same volume of the same Journal, p. 496, who obtained 4 grains of alkaloid from 1500 grains of coca, which is also about a quarter of one per cent. These assays were, however, very old, and made by the old process. The process used by the writer was the more modern one of Dragendorff slighty modified. It was as follows:—

Thirty grammes of powdered coca, thoroughly mixed in a mortar with 8 grms. of caustic magnesia, was stirred into 200 c.c. of boiling water, and the mixture boiled for ten minutes. The liquid was filtered off, and the residue percolated with about 60 c.c. of water. It was then again stirred into 150 c.c. of boiling water, and was again boiled and percolated until apparently thoroughly exhausted. The total liquid, amounting to more than 600 c.c., was evaporated on a water-bath, commencing with the weaker portions, so that the stronger ones might be exposed to the heat for the shortest time—until reduced to about 20 c.c. This liquid extract was transferred to a flask and vigorously shaken with 50 c.c. of strong ether. The ether was poured off, as closely as practicable, into a tared capsule, where it was allowed to evaporate spontaneously. A second and third portion of ether, each of 50 c.c., were used in the same way, and then the whole evaporated to dryness in the capsule. A scanty, greenish, oily residue was left in the capsule, in which there was no appearance of a crystallised alkaloid. The capsule and contents were then weighed and the weight noted. The oily residue was then repeatedly washed with small quantities of water, until the washings no longer affected litmus-paper. The oily matter adhered to the capsule during this process, no part of it coming off with the washing, and at the end of the washing the capsule and contents were again dried and weighed, and the weight subtracted from the original weight. The difference was taken as the alkaloid cocaine, and it amounted to 0·077 grm., equal to 0·26 per cent.

Several preliminary assays were made in reaching this method. Some authorities recommend the very finely powdered mixture of coca and magnesia, or coca and lime, to be at once exhausted with ether. Others recommend that the mixture be made into a paste with water, and after drying on a water-bath that it be then exhausted with ether. This is better, but neither of these methods were satisfactory.

Finally, 30 c.c. of a well made fluid extract of the same coca was thoroughly mixed with 8 grms. of caustic magnesia in a capsule, and the mixture dried on a water-bath and powdered. This powder was then exhausted, one part by ether and the other part by chloroform, exactly as in the method given, both parts giving very slightly higher results. As a check upon the results the solution of alkaloid washed out was titrated with normal solution of oxalic acid.

From all this it would appear that this inferior coca of the markets, or rather the best that can be selected from it, yields about the same proportion of the alkaloid as was obtained by Niemann and Maisch, but it has been shown that, by the older processes of assay used by them, much of the alkaloid was probably lost or destroyed, and that much better results are generally obtained by the modern process.

Now, since 3 drachms of this coca, or 3 fluidrachms of its fluid extract, gave the same physiological, or perhaps therapeutical, effect as 3 grains of caffeine, and as the 3 drachms contained about 0·45 grain of cocaine, it follows that cocaine is about 6·5 times more effective than caffeine; but it also follows that the coca accessible, and even the very best coca, contains very much less of its alkaloid than those articles which yield caffeine do of that principle.

THE ROYAL SOCIETY OF NEW SOUTH WALES.

Original Researches.

The Royal Society of New South Wales offers its Medal and a Money Prize for the best communication (provided it be of sufficient merit) containing the results of original research or observation upon each of the following subjects:—

Series IV.—To be sent in not later than May 1, 1885.
- No. 13.—Anatomy and Life History of the Echidna and Platypus. The Society's Medal and £25.
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The competition is in no way confined to members of the Society, nor to residents in Australia, but is open to all without any restriction whatever, excepting that a prize will not be awarded to a member of the Council for the time being; neither will an award be made for a mere compilation, however meritorious in its way—the communication to be successful must be either wholly or in part the result of original observation or research on the part of the contributor.

The Society is fully sensible that the money value of the prize will not repay an investigator for the expenditure of his time and labour, but it is hoped that the honour will be regarded as a sufficient inducement and reward.

The successful papers will be published in the Society's annual volume. Fifty reprint copies will be furnished to the author free of expense.

Competitors are requested to write upon foolscap paper, on one side only. A motto must be used instead of the writer's name, and each paper must be accompanied by a sealed envelope bearing the motto outside and containing the writer's name and address inside.

All commuuications to be addressed to the Honorary Secretaries.

A. Liversidge, }
A. Leibius, } *Hon. Secs.*

The Society's House,
37, Elizabeth Street, Sydney

PROCEEDINGS OF SOCIETIES.

PHYSICAL SOCIETY.

Ordinary Meeting, March 14th, 1885.

Prof. Guthrie, President, in the Chair.

Captain Abney read a paper upon "*Recent Researches on Radiation.*" In general, a hot body loses heat in three ways: by conduction, by convection, and by radiation. In the case of the carbon filament of an incandescent lamp, the loss of heat by conduction is insignificant, and a series of experiments has been made to determine the amount of radiation, that is, the energy expended as radiant heat for every unit of electrical energy expended in the lamp. Mr. Crookes has investigated the subject of radiation in high vacua, the cooling bodies being thermometer bulbs, and has come to the conclusion that at pressures between 40 millionths and 1 millionth of an atmosphere the radiation varies as the mean molecular free path. In the author's experiments incandescent lamps of thin glass were exhausted to different degrees, the radiation being measured by a thermo-pile. It was found that from 40 millionths to 10 millionths of an atmosphere the radiation increases uniformly with decrease of pressure, but that beyond this point it becomes nearly constant. A more important question is to determine the amount of radiation for any particular ray under the above conditions. This was effected by placing a small thermopile in the different parts of the spectrum. Plotting the results with Watts as abscissæ and radiation as ordinates, the curves for each kind of ray are found to be very accurately hyperbolas with vertical axes. This result gives a method for rendering identical the quality of the light emitted by two lamps. We have only to find the radiation corresponding to a particular kind of light for one lamp, and then, by examining the curve corresponding to that ray for the other lamp, find for what number of Watts the radiation is the same.

Prof. J. A. Fleming read a paper on "*Characteristic Curves of Incandescent Lamps.*" The author has collected a number of statistics concerning the life, resistance, efficiency, and potential difference of incandescent lamps, and has examined them with a view of showing the mutual relations of these variables by empirical equations. A curve showing the relation of any one of these to any other is called a characteristic curve of the lamp. Among the various results arrived at was the confirmation of the law announced by Profs. Ayrton and Perry at the last meeting of the Society, that for a certain class of lamps the potential difference *minus* a constant varies as the cube-root of the efficiency, the latter quantity being measured by candles per horse-power. The constant, which in the lamps examined is about 28·7, is nearly the potential difference at which the lamp begins to emit light; hence the law may be put into this form:—The effective potential difference varies as the cube-root of the efficiency. Using the results obtained, the author then solved the problem of determining the conditions for a minimum cost per candle, and obtained a result closely agreeing with that communicated at the last meeting by Profs. Ayrton and Perry.

In answer to Lord Rayleigh, Dr. FLEMING stated that he had not calculated the increase of cost due to a variation from the most favourable conditions. It had been shown, however, by Messrs. Ayrton and Perry that the increase of cost due to a variation of potential difference amounting to 3 or 4 per cent upon either side of the value corresponding to least cost was very small.

Mr. C. CLEMINSHAW described some "*Further Experiments in Spectrum Analysis.*" These consisted of methods of obtaining the inversion of the sodium line in the spectrum of the lime-light. The first consisted in concentrating the rays from the slit by a lens, just beyond the focus of which is a spoon in which sodium is ignited by a Bunsen flame. In the second method the burner and sodium are introduced between the lime and the slit, and carbonic acid is introduced into the flame. The result in either case is to cause the inversion of the D line.

Prof. GUTHRIE, alluding to the pale blue flame produced by common salt in a coal-fire, suggested that there might be more than a mere mechanical action produced by the carbonic acid. Mr. Cleminshaw, however, believed that the action was purely mechanical.

An abstract of a communication by Dr. JOHN HOPKINSON on "*Sir W. Thomson's Quadrant Electrometer,*" was read by the Secretary. According to Maxwell, the deflection produced by a given difference of potential between the quadrants is given by the formula,—

$$d=\lambda(A-B)\left(C-\frac{A+B}{2}\right),$$

where A and B are the potentials of the quadrants, and C that of the needle. Dr. Hopkinson, finds, however, that the constant λ should be—

$$\frac{\lambda}{1+kC^2},$$

the quantity k being due to, and depending on, the unsymmetrical position of the needle with respect to the quadrants.

NOTICES OF BOOKS.

Fresenius' Quantitative Analysis. Vol. II., Part 1. Translated by C. E. GROVES, F.R.S. London: J. and A. Churchill.

THE subject of the part before us is the ultimate analysis of organic compounds. The author begins with giving instructions for the qualitative examination of such compounds, or, as the translator prefers to call them, "organic bodies." To this term exception may be taken, since an entire plant or animal is an "organic body," consisting of a mixture of many chemical individuals. As tests for nitrogen we find given the well-known odour evolved when substances rich in nitrogen are strongly heated, and in doubtful cases the treatment of a small portion with potassium hydrate or soda-lime at a high temperature, and the detection of ammonia in the volatile products by its well known reactions. Concerning Lassaigne's test, the caution is given that it does not answer well with organic alkaloids containing oxygen. The student is further reminded that neither of these tests is trustworthy if the nitrogen exists in oxy-compounds. In proof of the importance of a preliminary qualitative examination when dealing with unknown substances, it is mentioned that taurine, which contains a large quantity of sulphur received at first the formula $C_4NH_7O_{10}$.

The process of quantitative determination is next expounded with the thoroughness which we have long been accustomed to find in everything proceeding from Prof. Fresenius. The student is informed that he "cannot with impunity deviate from the rules laid down, as they are the fruit of the long experience and the innumerable experiments of the most distinguished chemists." If he finds anything unsatisfactory in his results it will be safer for him to seek the cause in some defect in his working rather than in any shortcoming of the process.

We have first a tabular view of the methods proposed by different chemists for the various possible cases. Under each such process there is first a very full account of the appliances and preparations required. Each piece of apparatus is figured, and instructions are given for its use. Then follow directions for the performance of the analytical process, drawn up with a corresponding completeness. In this manner the author goes through Liebig's original process for non-azotised solids readily combustible and non-volatile compounds; Bunsen's modification of Liebig's method; the processes for sparingly combustible compounds, *i.e.*, combustion with lead chromate, with copper oxide and potassium chlorate, and with copper oxide and oxygen gas. Then follow directions for the determination of hygroscopic compounds, for such as suffer changes at 100°, and for liquids, volatile or fixed.

Next we have the case of bodies containing all four of the so-called organogens, including the determination of carbon and hydrogen as modified by the presence of nitrogen; the relative determination of nitrogen by volume according to the methods of Liebig, Bunsen, and Marchand, as modified by Gottlieb; the absolute volume method of Dumas, with the modifications of Thudichum, and Wanklyn, Simpson, and Wolcott Gibbs; the determination of nitrogen as ammonia according to Varrentrapp and Will, and to Peligot.

Next we have directions for the analysis of organic compounds containing sulphur, phosphorus, and the halogens; the analysis of organic substances containing inorganic compounds; for the direct estimation of oxygen; and for methods which differ from the ordinary processes without requiring a direct estimation of oxygen.

Lastly, come brief instructions for determining the equivalents of organic compounds, including the determination of vapour-densities and the calculation of analyses.

The part before us is translated from the first part of the latest German edition. Vol. II. is not yet complete in German, and it was thought advisable not to wait for a translation of the complete volume, but to issue parts according to the progress of the German edition.

This edition of the great work of Fresenius, judging from the portion before us, will be found highly satisfactory. There are none of those ill-judged, though well-meant, attempts at abridgment, which made a former English version unsatisfactory and called forth a protest from the author. The translation is clear and well executed.

Louis Pasteur: His Life and Labours. By his SON-IN-LAW. Translated from the French by Lady CLAUD HAMILTON. London: Longmans, Green, and Co.

THIS work, though "popular" in so far as it is perfectly intelligible to the non-scientific reader, will be found by chemical and biological specialists not merely interesting but suggestive. Among the most important of the labours of M. Pasteur are his early researches on the correlation between molecular dissymmetry and the power of rotating the plane of polarised light. He was led, it appears, to a conclusion touching the difference between lifeless and vital—or as we may, perhaps, better say—between inorganic products and those formed under the influence of life. The former, he declares, are atomically dissymmetrical, and hence have the power of turning the plane of polarisation. The latter are atomically symmetric, and are hence optically inactive. He maintains that such substances as oxalic acid, urea, uric acid, &c., though found in living creatures, are products of excretion rather than bodies essential to life. Upon this difference M. Pasteur seeks to found the essential difference between the organic and the inorgenic worlds. He contends that the molecular forces which operate in the mineral kingdom, and which are brought into play in our laboratories, belong to the symmetrical order, whilst the forces which are active in the sprouting seed, in the developing ovum, are of the dissymmetric order. He expressed this view on one occasion, at a meeting of the Academy of Sciences, in the following words:—"The universe is a dissymmetric whole. I am inclined to think that life, as manifested to us, must be a function of the dissymmetry of the universe or of the consequences that follow in its train. . . . Even the motion of solar light is dissymmetrical. A luminous ray never strikes in a straight line, and at rest the leaf wherein organic matter is created by vegetable life." He remains persuaded that the barrier between the inorganic and the organic worlds can never be crossed until we succeed in introducing among the reactions of our laboratories influences of the dissymmetric order.

It is right, however, to point out that Professor Tyndall in a valuable introductory chapter, regards M. Pasteur's association between life and dissymmetry insecure. He reminds the reader that quartz as a crystal exerts a very powerful twist on the plane of polarisation, whilst when in solution it exerts no power at all. Hence the molecules of quartz are symmetrical, whilst the crystal which they form is dissymmetrical. Thus the forces extant in mineral nature suffice to build up dissymmetric structures without the introduction of vitality. Further, molecular dissymmetry is not a fact, but an inference to account for the deflection of the plane of polarised light by certain bodies. Dissymmetry, argues Prof. Tyndall, arises from the composition of atomic forces, which when reduced to their most elementary action are exerted along straight lines. Faraday, in his first series of experiments, converted upwards of 150 symmetric and optically inert bodies into dissymmetrical and optically active ones.

To these views Pasteur had been led by his studies on tartaric acid. But his attention was drawn, accidentally it may be said, to a sphere less interesting from the point of view of pure science, though of greater direct practical moment. Being nominated Dean of the Faculty of Sciences at Lille, in a region where the manufacture of alcohol from grain and beet-root is largely carried on, he took up the question of fermentation. Here, in recognising a microbion as the agent, he came in collision with the views of Liebig, then dominant. This illustrious chemist taught that the ferments were indeed organic, but not organised,—nitrogenous substances in a state of alteration consequent upon the action of catalytic oxygen. The new view of Pasteur was, after much discussion, generally adopted, and its first practical application was in the manufacture of vinegar. By a not unnatural transition he thence passed on to spontaneous generation, or, as it is now more learnedly styled, "abiogenesis." In the work before us we find quoted Van Helmont's recipes for producing scorpions and mice,—neither of them desirable as experimental results. In 1858 Pouchet, Director of the Rouen Museum of Natural History, declared that he had succeeded in proving the existence of microbia which had not originated from parents like to themselves. Pasteur soon found a flaw in the experiments of Pouchet, and when the experiments were repeated without this source of error no organisms appeared.

We next come in succession to Pasteur's studies on wine, and to his investigation of the silkworm disease,—a scourge which he disarmed to a very considerable extent. From this investigation he passed to an investigation of the epizootics of cattle and poultry, splenic fever, and fowl cholera, and devised a preventive,—the attenuated virus, which if applied in a manner analogous to vaccination renders the animal refractory to the original deadly infection.

Lastly, he turned his attention to rabies, and here also he has been successful in producing a "vaccine," which has so far proved a complete safeguard. Whether the protection will prove permanent or will require to be repeated time alone can demonstrate. The skill displayed by Pasteur in these investigations was, perhaps, even less noteworthy than the calmness with which he conducted his experiments under circumstances of the most imminent danger.

We should scarcely be doing our duty if we did not refer to the general impulse which Pasteur's labours have given to the prevention of zymotic disease. The antiseptic treatment of wounds, and the new "vaccine" for yellow fever now being tried at Rio Janeiro, are indirectly the fruits of his researches.

Our satisfaction with this work would have been unmixed if its author had not been led by an excess of zeal to refer somewhat uncourteously to those whom he views as the opponents or the rivals of his hero. An instance of this shortcoming, in reference to Dr. Koch, is mentioned regrettingly by Prof. Tyndall in his introduction.

Practical Physics. By R. T. GLAZEBROOK, M.A., F.R.S., and W. N. SHAW, M.A. London: Longmans, Green, and Co.

THE authors of this volume are Demonstrators at the Cavendish Laboratory, Cambridge. In the course of their extensive experience in conducting the large elementary classes in practical physics, they found it necessary to write out the practical details of the experiments to be performed by the students. These manuscript notes have been collected and form the substance of the present treatise.

From it we find with satisfaction that the method of teaching chemistry in the Cavendish Laboratory is essentially practical. The student learns by experimenting, and is thus trained for original research. Messrs. Glazebrook and Shaw give the following description of the mode of tuition adopted during the past year. Proof-sheets of the work before us, divided into sections, are pasted in MS. books, the remaining pages being available for entering the results obtained by the students. The apparatus referred to in each book is grouped together on one of the tables in one large room. The students are generally arranged in pairs, and before each day's work the demonstrator in charge assigns to each pair of students one experiment. A list showing the names of the students and the experiment assigned to each is hung up in the laboratory, so that each member of the class can know the section at which he is to work. He is then set before the necessary apparatus, with the MS. book to assist him; if he meets with any difficulty it is explained by the demonstrator in charge. The results are entered in the books in the form indicated for the several experiments. After the class is over the books are collected and the entries are examined by the demonstrators. If the results and working are correct a new section is assigned to the student for the next time; if they are not so, a note of the fact is made in the class list and the student's attention called to it, and if necessary he repeats the experiment.

It is evident that whoever studies physics in this manner, even if he has no intention of qualifying himself for research, must obtain a far clearer and more precise knowledge of the science than can possibly be gleaned from books, lectures, and from merely witnessing experiments.

The successive chapters of the book discuss physical measurements, units of measurement, physical arithmetic, the measurement of the more simple quantities, measurement of mass and determination of specific gravities, the mechanics of solids, mechanics of liquids and gases, acoustics, thermometry and expansion, calorimetry, vapour-tension and hygrometry, photometry, mirrors and lenses, spectra, refractive indices and wave-lengths, polarised light, colour vision, magnetism, electricity with definitions and explanations of electrical terms, experiments in the fundamental properties of electric currents, measurement of electric current and electromotive force, Ohm's law with the comparison of electric resistances and electromotive forces, and the galvanometric measurement of quantity of electricity.

Teachers of physics who have the needful apparatus at their disposal will find this work an excellent practical guide.

Aids to the Analysis of Food and Drugs. By H. AUBREY HUSBAND, M.B., B.Sc., &c. London: Baillière, Tindal, and Cox.

THE number of drugs considered in this little work is not great. Tincture of camphor, sweet spirits of nitre, and limejuice, make up the total. The author evidently does not take up the position of an alarmist, for, after enumerating the sophistications supposed to occur in tea, he adds the remark:—"Most of these adulterations are only found in samples of tea submitted to candidates under examination." In like manner he writes, in speaking of coffee:—"Most of these are imaginary, and none of them can be used in the case of the unground bean, except, perhaps, burnt sugar." Sugar, treacle, and the various articles of confectionery are omitted. Nor do we find any mention of cheese, pickles, tinned fruits, and other provisions put up in metallic capsules. The process given for the analysis of water is mainly based upon the well-known treatise of Mr. J. A. Wanklyn. Here, however, and indeed throughout the book, Dr. Husband makes use of decems for the measurement of liquids. The entire compass of the work is very brief—77 pages only—and hence none of the processes can be described at very great length.

Laboratory Text-book for Brewers. By LAWRENCE BRIANT, F.C.S. London: Thomas Briant, 1884.

THIS little text-book is one that will, we think, prove useful to students of brewing as well as to practical brewers. Some of the matter that is given is more or less of an elementary character, but as it all bears on the special subject of brewing this may render the work more useful among the smaller brewers who do not employ a chemist. The book is divided into seven parts, in which those carbohydrates and albumenoids of special interest to the brewer are described; the simple analytical operation, such as the washing, drying, and igniting of precipitates; the use of pipettes, burettes, &c.; and the analytical methods employed for sugar, water. beer, malt, hops, and bisulphite of lime are given. Part IV., on the interpretation of the results of analyses, and Part VII., in which numerous typical analyses are given, form valuable features in this book.

We can recommend this work as being evidently a careful and trustworthy compilation; but we think a few more drawings might have been scattered through the text, and certainly a table of contents ought not to have been omitted.

On the Rotatory Power of Invert Sugar. By OTTO GUBBE.

THE author of this pamphlet considers experimentally the three questions: the influence of the acid employed to invert sugar, the rotatory power of the invert sugar, and the influence of concentration and temperature. The acids used are sulphuric, hydrochloric, and oxalic, and he finds that the two former produce a slight increase in the specific rotatory power of the invert sugar nearly proportional to the amount of acid employed. He also gives a series of equations connecting concentration and temperature with rotatory power.

CORRESPONDENCE.

SEPARATION BY CAPILLARY ATTRACTION.

To the Editor of the Chemical News.

SIR,—I trust that what promised to be of interest in connection with capillary attraction will not receive its deathblow in your columns from the authoritative announcement by Mr. Bayley that Mr. Lloyd has made a rediscovery. Men who have grasped the highest rung of the ladder of fame do this sometimes.

Dr. Angus Smith once asked the writer what he meant by new as relating to scientific facts,—a question not to be answered off-hand.

What Mr. Bayley did with certain metallic solutions and strips of filter-paper in 1878 is antecedent certainly to the work of Mr. Lloyd, but the knowledge that filtering-paper can dissociate bodies from their solutions dates, at any rate, to 1861.

In that year Dr. F. Goppelsrœder communicated to the Société Industrielle de Mulhouse some observations he had made of the property possessed by filtering-paper of dissociating the aniline colours from their solutions in alcohol; and an attempt was made to found a qualitative test on the principle referred to. It consisted in dipping the end of a strip of white filtering-paper a few millimetres long into an alcoholic solution of the colour. Were this, say, rosaniline alone, four zones or lines of demarcation would present themselves, the highest on the paper being colourless, whilst the remaining three would vary from light rose to a dark red, almost black. The darkest zone Dr. Goppelsrœder tells us was in the centre. On the addition of a little picric acid he noticed three descriptions of bands, some of a dark rose and red, colourless ones, and one of a fine yellow. This latter, he says, is of greater or lesser width in proportion to the picric acid present.

An alcoholic solution of azuline (probably the blue produced by heating rosolic acid with aniline) gives, after a while. four zones differently coloured: starting with the lowest, a blue, next a violet, then a rose, and lastly a colourless one. The rose band treated separately with alcohol gave a rose-coloured solution, whilst the blue one furnished a blue solution, with which silk could be dyed of a purer blue than was possible with the azuline of commerce.

Dyers and calico-printers have long been aware that cotton can attract both alumina and ferric oxide from basic solutions, and I find that quite recently M. H. Kœchlin has been able to fix chromium oxide on cotton by means of the acetate along with alkali, without the necessity of "ageing" the fabric, as is the usual practice.

I would suggest to Mr. Lloyd the following experiment:—Make up a 5 per cent solution of acetate of alumina, and one of the same strength of acetate of iron (ferrous acetate), and mix in equal volumes. Allow to dip in the mixture the end of a strip of cleansed cotton, cover the arrangement with a bell-jar, and note what takes place.

I anticipate, though I have not tried the experiment, that the iron salt will soon show signs of dissociation, as evidenced by dark coloured zones near the liquid. To what extent the alumina can free itself from the iron in the higher portions of the cotton could be found by subsequently drying the strip with alizarine after "ageing" and washing in warm water containing chalk. Could mixed mordants be qualitatively tested in this way?—I am, &c.,

P. H.

Action of the Diastase of Malt upon Crude Starch.—L. Brasse.—The author calls attention to the fact that amylase does not exert the slightest digestive action upon starch in its natural state.—*Comptes Rendus.*

CHEMICAL NOTICES FROM FOREIGN SOURCES.

Note.—All degrees of temperature are Centigrade unless otherwise expressed.

Comptes Rendus Hebdomadaires des Séances, del'Académie des Sciences. Vol. c., No. 6, February 9, 1885.

The Velocity of the Propagation of Detonation in Solid and Liquid Explosives.—M. Berthelot.—According to experiments made chiefly with gun-cotton, the speed of propagation increases with the density of the charge. It incerases also with its diameter; at least within the limit of the very narrow tubes used in the author's experiments. It seems further to increase with the resistance of the casing. Comparative experiments made with a very winding tube of 200 m.m. and with a rectilinear tube of the same dimensions gave substantially the same velocity.

New Refrigerating Machine based on the Use of Physico-Chemical Phenomena.—R. Pictet.—In refrigerating machines, up to the present time, there has been utilised as the sole source of cold the passage of liquid to the gaseous state without the intervention of any chemical phenomenon. The various systems of such machines differ merely in the absolute tension of the vapours on both sides of the compressing piston, and in details of arrangement. Instead of a single liquid M. Pictet proposes to use a volatile liquid which may be split up into two or more volatile liquids by the mere fact of a fall of temperature. He has oxidised carbonic acid by associating it with sulphur oxide, and has obtained a series of compounds from $C_{40}O_{82}S$, boiling at −71° to $CO_{16}H_7$, boiling at −7·5°. The more the temperature sinks, the more the original liquid is resolved into elementary volatile liquids, each giving off vapours. The sum of all these elementary tensions is much more considerable than that which would correspond to a single permanent liquid. At higher temperatures all these liquids re-combine into one, and the maximum tension of the vapours is considerably reduced under the influence of the affinities developed. If we introduce into a refrigerating machine the new volatile liquid SCO_4, the vapour tension in the refrigerant will be very much superior to that of pure sulphurous acid, whilst the tension on compression in the condenser, where the vapours resume the liquid state, will be decidedly less than that of sulphurous acid. The compressing piston will thus receive a stronger pressure in aspiration, but a smaller one in compression, thus effecting a great economy in the force required for working the pump.

The Variation of the Electric Resistance of Bismuth placed in a Magnetic Field.—M. Hurion.—The author's recent experiments have confirmed his former result and that of M. Righi, that the resistance increases when the metal is placed between the poles of an electro-magnet, and that the increase is more rapid than that of the intensity of the magnetic field.

Temperature of the Solidification of Nitrogen and of Carbon Monoxide; Relation between the Temperature and the Pressure of Liquid Oxygen.—K. Olszewski.—Nitrogen is solidified at a temperature of −214° and under a pressure of 60 atmospheres, its critical point being −146° under the pressure of 35 atmospheres. By carrying the rarefication to 4 m.m. of mercury the author has succeeded in obtaining a temperature of −225°. The solidification point of carbon monoxide is −207° with a pressure of 100 m. of mercury. Oxygen still remains liquid at a temperature considerably below −211°.

The Solution of Magnesium Carbonate in Carbonic Acid.—R. Engel.—The author concludes that the solubility of magnesium carbonate in water in presence of carbonic acid follows the law of two progressions.

The Action of Sulphur upon Red Phosphorus.—F. Isambert.—Red phosphorus differs accordingly as it has been obtained at a higher or lower temperature. If obtained at a high temperature, and gradually heated with sulphur to 260°, it combines slowly and without the least trace of explosion. The red phosphorus of commerce, if heated to 180°, combines with phosphorus with a very feeble explosion.

The Monazite Sands of Caravellas, in the Province of Bahia.—H. Gorceix.—These sands consist of titaniferous iron, zircon, and monazite rich in didymium.

On Benzine β-hexachloride.—J. Meunier.—The author describes a benzine trichloride formed on the decomposition of the β-hexachloride, either by heat or by boiling with alcoholic potassa.

Modifications produced in the Composition of certain Animal Fluids under the Influence of Epidemic Cholera.—A. Gabriel Pouchet.—See p. 119.

Optical Inactivity of Cellulose and especially of such as is separated from a Solution of Cotton in the Ammonio-cupric Reagent.—A. Béchamp.—The author demonstrates not only that there is a soluble and inactive modification of cellulose, but that this inactivity pertains also to the insoluble modifications of this substance and consequently to cotton itself. It is inactive cotton which modifies the peculiar activity of the ammonio-cupric reagent.

No. 7, February 16, 1885.

Extraction of the Green Matter of Leaves; Definite Compounds formed by Chlorophyll.—E. Guignet.—Chlorophyll when isolated is very soluble in alcohol as well as in benzol or in petroleum ether. Leaves, either fresh or dried, however, do not give off their chlorophyll to petroleum ether, but merely a mixture of yellow or colourless matters. Hence it seems that the chlorophyll is contained in envelopes insoluble in petroleum ether, but soluble in alcohol. The deep green alcohol extract of dried and powdered leaves, if refrigerated, yields an abundant deposit of yellowish or colourless matter insoluble in petroleum ether. Chlorophyll is very unstable in presence of dilute acids, or even of pure water. It is very stable in presence of bases, behaving like a true acid. Hence M. Fremy gave the name of phyllocyanic acid to the green matter of leaves when freed from the accompanying yellow matters. With bases it forms definite salts; those of potassium and sodium being very soluble in water, but insoluble in absolute alcohol and in petroleum ether. The lead salt is insoluble. Chlorophyll may be found unchanged in the excretions of herbivorous animals, and even in peat.

Heating-power of Coal-gas in various States of Dilution.—A. Witz.—Coal-gas, well purified and mixed with six times its volume of air, has a heating power of 5200 cal. per cubic metre at 0° and 760 m.m. Before purification its heating power is 5600 cal. The heating power of gas is increased by 5 per cent when it is mixed with 1·25 vols. of oxygen, but, on the contrary, it is dimininished by 4·6 per cent when diluted with 11 vols. of oxygen. This rule does not hold good when the gas is mixed with common air.

The Laws of Solution.—H. Le Chatelier.—The author argues that solubility increases with temperature in case of bodies which absorb heat during the act of solution, but decreases, on the contrary, in those which give out heat, whilst it does not change in either direction when the heat of solution is null.

A Crystalline Hydrate of Phosphoric Acid.—A. Joly.—The author describes a hydrate to which he assigns the formula PO_5HO.

The Solution of Magnesium Carbonate in Carbonic Acid.—R. Engel.—The author investigates the influence of temperature upon the solubility of metallic carbonates in water charged with carbonic acid; his experiments have been made upon the crystalline magnesium carbonate.

Cellular Structure of Melted Steel.—MM. Osmond and Werth.—Microscopical examination shows that molten steel possesses a kind of cellular tissue, the iron forming the nucleus and the carbon the envelope of the cellules. These simple cellules form agglomerations which the authors term compound cells. These latter cells may be easily identified with what is ordinarily called the grain of the steel; their surfaces are therefore regions of least cohesion. Hence the fracture of a bar of steel is the surface which contains a minimum of carbon.

On Glycol Mono-chlorhydrate.—G. Bouchardat.—The author points out certain peculiarities in the preparation of mono-chlorhydric glycol.

The Preparation and Solidification of Glycol.—G. Bouchardat.—The author obtains glycol by causing a solution of potassium carbonate to act upon ethylene bromide by Zeller and Huefner's process. Pure anhydrous glycol, boiling at 197·5°, was refrigerated progressively. Under the influence of cold and vibration the glycol solidifies easily at temperatures varying from −13° to −25°.

MISCELLANEOUS.

"On the Use of Nitrate of Soda as Manure."—(Prize Subject.)—The Committee of the Saltpetre Producers' Association on the West Coast of South America (Comité Salitrero at Iquique, Chili) offers £1000 in prizes for essays on the use of nitrate of soda as manure. Of this amount—

I. A Prize of £500 will be awarded for the best popular essay showing the importance of nitrate of soda as a manure, and the best mode of its employment. The essay, in its theoretical part, is to treat of the effect of nitrate of soda on vegetation, as compared with other manures containing nitrogen, and should exhibit the present state of knowledge on this point. In its practical part the essay is to give directions for the use of nitrate of soda in the various conditions of plant-culture. References and quotations, and purely scientific explanations, if necessary, are to appear as notes. The essay may be written in English, German (Italic characters), or French. The writing must be distinct, and on one side of the paper only. It is desired that the length of the essay may not exceed six sheets of printed octavo. Each manuscript is to be signed with a motto; the name and address of the author is to be given in a sealed envelope bearing the motto outside. The essays are to be sent in on or before October 1, 1885, to any of the undermentioned judges.

II. A Prize of £500 will be awarded for the best essay treating of the same subjects on the basis of New Experimental Researches made by the author himself. The essays must fulfil the conditions already mentioned. They may be sent to any of the judges on or before January 1, 1887.

The Committee of Judges consists of the following Agricultural Chemists:—

Germany.—Prof. Paul Wagner, Director of the Agricultural Station at Darmstadt.

England.—R. Warington, Esq., Agricultural Laboratory, Rothamsted, St. Albans, Herts.

United States of America.—Vacant.

France.—Prof. L. Grandeau, Director of the Agricultural Station, and Dean of the Faculty of Natural Philosophy, at Nancy.

Belgium.—Prof. Petermann, Director of the Royal Agricultural Station at Gembloux.

Holland.—Prof. Adolf Mayer, Director of the Agricultural Station of the State at Wageningen.

Russia.—Prof. L. Thoms, Director of the Agricultural Station at the Polytechnical Institution at Riga.

If none of the essays received should thoroughly satisfy the Committee of Judges, they are authorised to award inferior prizes, of not less than £150 each. Any essay for which a prize shall be awarded becomes the absolute property of the Saltpetre Producers' Association at Iquique, which also reserves to itself the right of translation into other languages.—(Signed) Prof. Paul Wagner, Darmstadt, for the Comité Salitrero at Iquique.

NOTES AND QUERIES.

*** Our Notes and Queries column was opened for the purpose of giving and obtaining information likely to be of use to our readers generally. We cannot undertake to let this column be the means of transmitting merely private information, or such trade notices as should legitimately come in the advertising columns.

Water-Gas.—A correspondent wishes to be referred to towns in which water-gas is made, and would also like to have the names of the manufacturers of this at Manchester.

MEETINGS FOR THE WEEK

Monday, 23rd.—Medical, 8.30.
—— Society of Arts, 8. (Cantor Lectures.) "Carving and Furniture," by J. Hungerford Pollen.
Tuesday, 24th.—Royal Institution, 3. "Digestion and Nutrition," by Prof. Gamgee.
—— Institution of Civil Engineers, 8.
—— Royal Medical and Chirurgical, 8.30.
Wednesday, 25th.—Society of Arts, 8. "The Musical Scales of Various Nations," by A. J. Ellis, B.A.
—— Geological, 8.
Thursday, 26th.—Royal, 4.30.
—— Royal Society Club, 6.30.
—— Royal Institution, 3. "The New Chemistry," by Prof. Dewar.
Friday, 27th.—Royal Institution, 8. "The Motor Centres of the Brain, and the Mechanism of the Will," by Prof. Victor Horsley, at 9.
—— Quekett Club, 8.
Saturday, 28th.—Royal Institution, 3. "Richard Wagner," by Mr. C. Armbruster.
—— Physical Society, 3. "On Calculating Machines," illustrated by a collection of ancient and modern machines, lent by their owners for the occasion, by Mr. Jos. Edmundson. Exhibition of Instruments by Prof. Kennedy, Colonel E. D. Malcolm, Conrad C. Cooke, and A. Hilger.

PATENTS, DESIGNS, & TRADE MARKS ACT, 1883.

IN THE MATTER of Letters Patent granted to William Edward Gedge, of No. 11, Wellington Street, Strand, London, for "Improvements in the manufacture of blasting-powder from nitrated cellulose" (a communication from Wilhelm F. Wolff and Max Von Förster), dated 13th October, 1884, No. 13,522.

NOTICE IS HEREBY GIVEN, that the said William Edward Gedge has applied, under Sections 18 to 21 of the Patents, &c., Act, 1883, and Rules 48 to 56 of the Rules made thereunder, for leave to amend the Specification filed in pursuance of the said Letters Patent. A copy of the said Specification, as proposed to be amended, can be inspected at the Patent Office, and full details of the proposed amendment were published in the Official Journal of the Patent Office for the 10th March, 1885, No. 124, page 672.

Any person or persons intending to oppose the said application must leave particulars in writing of his or their objections to the proposed amendment at the Patent Office, 25, Southampton Buildings, Chancery Lane, London, W.C., within one calendar month from the date thereof.

Dated this 10th day of March, 1885.

H. READER LACK,
Comptroller General.

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"There is so much information of value contained in the volume that it will be a useful addition to the working library of chemists and engineers, even when they are not directly connected with the alkali trade."—*Engineer*, January 16, 1885.

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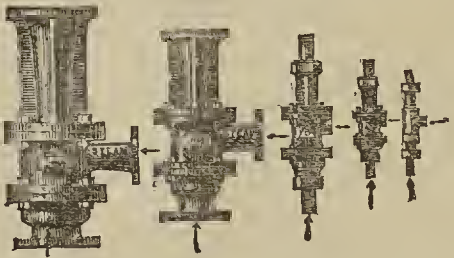

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THE CHEMICAL NEWS.

Vol. LI. No. 1322.

RESEARCHES ON SAMARIUM.

By P. T. CLÈVE.

The following is a summary of the author's researches, which will appear in full in the *Transactions af the Scientific Society of Upsala*:—

For the separation of samarium from the other earths of cerite and yttria there are no very complete methods. Samarium appears to accompany didymium wherever the latter element occurs, and they can be separated only by means of very tedious and minute proceedings. The best method seems to consist in the partial precipitation of the nitrates in a cold and very dilute solution by means of dilute ammonia. The samarium becomes concentrated in the first fractions, which must be submitted to repeated precipitations until the absorption-spectrum of didymium is eliminated. We obtain thus a mixture containing, in addition to samaria, the earth Y*tα*, the earths of yttria, &c. We may then precipitate the samaria by means of potassium sulphate, which gives with samarium a double salt sparingly soluble in the solution of potassium sulphate. Although the earths which accompany samaria yield double sulphates much more soluble, it is very difficult to separate them entirely. The samaria always retains a yellow tint due to terbia. The best method for obtaining it pure consists in precipitating it a great many times with ammonia. The first fractions are much darker than the last, which become at last almost white.

The atomic weight of samarium has been determined by the synthesis of the sulphate, setting out with a known weight of the oxide. Six experiments gave results varying from 149·940 to 150·120, the mean being 150·021, a number so close upon 150 that the latter figure may be accepted.

All the determinations have been made with different fractions, proving that the atomic weight is constant.

The ignition-spectrum of samarium consists of a great number of rays, which have been very exactly noted down by M. Thalén (*Ofversigt of Kongl. Svenska Vaten. Akademiens Förhandlingar*, 1883, No. 7, p. 3), who has determined the position of 198 rays.

The solutions of the samarium salts are remarkable for their absorption-spectrum, which has been studied by MM. Lecoq de Boisbaudran, Soret, and Thalén.

According to Soret there are absorption-bands even in the ultra-violet region, and, according to Becquerel, also in the ultra-red (Frémy, "Encyclopédie Chimique," vol. iii., p. 147). Metallic samarium has not yet been isolated.

Samarium oxide, Sm_2O_3, is a white powder very slightly inclining to yellow; it is infusible, and is not reduced in a current of hydrogen. It does not take a higher stage of oxidation if heated in a current of oxygen. It dissolves easily in acids, yielding yellow salts. Its sp. gr. is 8·347, and its molecular volume 41·7.

Samarium hydroxide is a gelatinous precipitate: after desiccation it forms resin-like fragments of a yellow colour. It absorbs carbonic acid from the air, but less readily than the hydrates of lanthanum and didymium.

The salts of samarium have a sulphur-, or a topaz-yellow colour, but when in powder they are almost white. The solutions have a sugary, but at the same time strongly astringent, taste. Their reactions are similar to those of the other earths. They give with the alkalies and the hydrosulphates precipitates of hydrates insoluble in excess f the reagents. The alkaline carbonates give amorphous recipitates, easily soluble in excess, but sparingly soluble ouble salts soon crystallise out. Oxalic acid precipitates the oxalate in the form of a curdy mass, which soon becomes pulverulent. The oxalate is almost insoluble in water, but dissolves in hot strong nitric acid. The alkaline oxalates precipitate white powders in a fine state of division, consisting of double oxalates.

Sodium acetate and hyposulphite produce no precipitate. Potassium ferrocyanide throws down a dirty yellow precipitate of a triple salt. Tartaric acid gives a white bulky precipitate, soluble in ammonia. The ammoniacal solution after some time—or immediately on the application of heat—deposits a white powder. Potassium sulphate gives with salts of samarium a sparingly soluble precipitate of a double salt. The saturated solution of the potassic salt contains about 0·5 grm. of Sm_2O_3 per litre.

The determination of samarium is effected in the same manner as that of lanthanum and didymium. Samarium may be determined as oxide, obtained by the ignition of the hydrate or of the oxalate, or even as sulphate, which bears an incipient red heat. Samaria cannot be completely separated from phosphoric acid by fusion with sodium carbonate. The complete separation is effected by means of oxalic acid.

Samarium fluoride is a gelatinous transparent precipitate which becomes pulverulent on heating. The chloride forms large crystals, deliquescent in moist air. The oxychloride is obtained by heating the oxide in a current of chlorine. The oxide swells up with incandescence, and gives a white powder of the specific gravity 7·017. The bromide crystallises over sulphuric acid in large, very deliquescent tabular crystals.

The author has further formed and examined the chloroplatinate, chlor-aurate, bromo-aurate, samarium-potassium ferrocyanide, samarium platino-cyanide, sulphocyanide, nitrate, periodate, the two sulphates anhydrous and crystalline, the double sulphates of samarium-potassium, samarium-sodium, samarium-ammonium, the anhydrous and crystalline seleniates, the samarium-potassium and samarium-ammonium seleniates, the sulphite, selenite, the carbonate, the double potassium, ammonium, and sodium carbonates, the ortho-phosphates, hydrous and anhydrous, the pyro-phosphate, the anhydro-meta-phosphate, the vanadiates, borate, molybdates, meta-tungstate, samarium-potassium chromate, formiate, acetate, propionate, oxalate, the samarium-potassium oxalate, the ethyl-sulphate, succinate, tartrate, and citrate.—*Soc. Chimique de Paris.*

ON A SINGULAR PROCESS OF SUGAR ANALYSIS.

By P. CASAMAJOR.

Some dozen years ago there appeared in the *Journal des Fabricants de Sucre* a letter signed "Un Abonné," calling attention to an empirical process of sugar analysis, used by Parisian sugar testers. This communication was the occasion of denials of its truthfulness by several sugar testers, and also of counter-statements by chemists who confirmed the accuracy of the statements of "Un Abonné."

I have reason to believe that such a process was used pretty generally at that time, because, having occasion, shortly after the appearance of the letter of "Un Abonne," above mentioned, to test several marks of a cargo of raw beet sugar from France, I found that the tests by the empirical process there given agreed more closely with the tests made in Europe than those obtained by the optical saccharimeter.

This empirical process is called "Process of the $\frac{4}{5}$." To test a sugar by it, the water is determined by evaporation, and the ashes by incineration, after addition of sulphuric acid. These are the only tests actually made. They require a very small outlay for apparatus. The return of the analysis of a sugar is made on a blank of this form:—

Sugar..	
Glucose	
Ashes..	
Water	
Organic matters, not saccharine, and loss..	
Total..	100

To fill up this blank, the water and the ashes are first put down as found by actual tests. The other constituents are obtained by what may be called *guessing*, within prescribed rules. To get at "organic matters, not saccharine, and loss," the sugar tester takes ⅘ of the quantity of ashes as determined by actual test, and hence the name of "⅘ process." After which there only remain "Sugar" and "Glucose" to fill up. and these are easily got. Beet sugars contain very little glucose (invert sugar), so no serious mistake can occur in guessing at this. The sugar tester, however, is guided by the colour of the sugar. If this is dark compared to most beet sugars, the glucose is estimated at about ¾ of 1 per cent. If the sugar is light glucose is put down at about $\frac{1}{10}$ of 1 per cent. Intermediate colours give intermediate percentages of glucose. As the quantity is never very great no important mistake can be made in the item of glucose.

As to the item which figures as "sugar" it is very easily obtained by adding up all the others and subtracting the sum from 100.

Take, as a numerical example, a beet sugar, having 3 per cent of water and 2½ per cent of ashes. According to what has been said, the analysis would be given as follows, supposing that the colour of the sample justified guessing that glucose was equal to 0·3 per cent.

Sugar	92·20
Glucose	0·30
Ashes	2·50
Organic matter, not saccharine, and loss..	2·00
Water	3·00
Total..	100·00

To understand how such a process could ever have come into use, we must remember that most raw beet-sugars are of very high grade compared to the generality of raw cane-sugars. After deducting water and real sugar, as ascertained by actual analysis, the remainder is comparatively a small percentage. If now the ashes are found generally to be about $\frac{5}{9}$ of the total remainder, it is conceivable that a process like this may give in most cases results which are satisfactory to the buyer and to the seller.

But there remains something else to be considered in relation to this process: It is that beet sugars are sold on the basis of *rendement*, formed on the assumption that 1 per cent of ashes prevent the crystallisation of 5 per cent of sugar. Now, in the numerical example given, the sugar being stated at 92·20, we would have to deduct 2½ × 5 = 12·50 from 92·20, to obtain, as *rendement*, 79·70 per cent. In doing this we have actually done the same thing as taking the water (equal to 3 per cent) and glucose (0·30) from 100, which leaves 96·7. Now we take the ashes (= 2½), add ⅘ as much and get 2·50 + 2 = 4·50. We now multiply the ashes by 5(2·50 × 5) and get 12·50, which, added to 4·50 makes a sum equal to 17. This, deducted from 96·70, leaves as *rendement* 79·70, the number already given. To obtain it we have deducted from 100 the following quantities:—

Percentage of water, as determined ..	3
,, ,, glucose, guessed at	·30
,, ,, ashes, multiplied by 6⅘ = 2·50 × 6·8	17
	20·30

The percentage of ashes is incomparably the most important element in a sugar analysis by this process.

In the way that a chemist is expected to make a sugar analysis, he is to determine the sugar by the optical saccharimeter, the water by evaporation, and the ashes by incineration.

Indeed the water is of no importance, and may be left out of the ordinary commercial analysis. From the sugar as given by the saccharimeter, the sugar tester deducts 5 times the weight of the ashes. The result is the *rendement*. If the sugar should be found to be 92 per cent, and the ashes 2·50, the *rendement* would be 92 − (2·5 × 5) = 79 per cent. It is on this number, 79, that the sale of beet-sugar is based in all European markets, which is a fact of itself more extraordinary to me than the ⅘ process. The "coefficient 5," which is generally accepted, is based on nothing but assumptions which have no foundations. Those who are willing to buy and sell by the "coefficient 5," need find no fault with the ⅘ process.

My attention has been called to a description of the ⅘ process in Wurtz, *Dictionnaire de Chimie*, iii., p. 67. After describing Clerget's process, the author of the article says:—"Depuis un certain temps, pour éviter un dosage aussi long, on employe, dans les laboratoires, un procédé beaucoup plus simple et qui donne des résultats à peu près exacts." . . . Then follows a brief description of the ⅘ process.

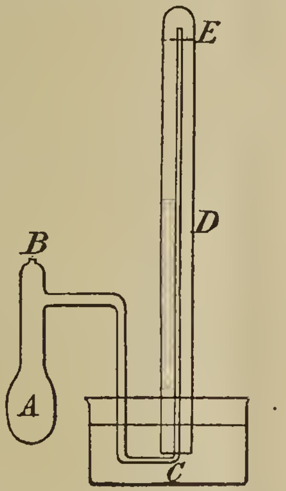
NOTE ON THE OCCLUSION OF HYDROGEN BY ZINC DUST AND THE METEORIC IRON OF LENARTO.

By GREVILLE WILLIAMS, F.R.S.

In a Preliminary Notice "On the Synthesis of Trimethylamine and Pyrrol from Coal Gas, and on the Occlusion of Hydrogen by Zinc Dust," which appeared in the *Journal of Gas Lighting* for Jan. 6 last, p. 15 (also Chem. News, vol. li., p. 15), I showed that the latter behaved with coal gas, and also with hydrogen, in a similar manner to palladised pumice, in so far that both metals take up hydrogen under certain conditions, and give it off in an active state at moderately elevated temperatures. I now propose to give the results of experiments made to determine the amount of hydrogen contained in the zinc dust used by me. I should have preferred to delay the publication of this "Note" till I had ascertained the conditions under which the hydrogen had been taken up; but my duties leave so little time for research that it is uncertain when I may be able to return to the subject.

Preliminary experiments showed that the commercial zinc dust used by me already contained hydrogen, and readily gave it off on heating to a temperature below the fusing-point of glass. It was not necessary, therefore, to use a Sprengel pump, as in Graham's determination of the hydrogen contained in the meteoric iron of Lenarto. The apparatus used by me in the quantitative estimation by volume was of the following simple construction:—Having introduced 6·4790 grms. into one of the small retorts, A, usually employed for determining boiling-points, I thickened the neck in the blowpipe flame, drew it out, and bent it three times at right angles. I then drew out and closed the tubulature at B. A vessel, C, containing water, and a graduating tube, D, were placed in the positions showed in the illustration. The gas-tube contained water up to the line E. The volume of air in D, and the temperature and pressure were then noted. On heating the retort to as high a temperature as it would bear without change of form, all the hydrogen was driven off and collected in D. On cooling to the atmospheric temperature, the increase of volume, corrected to 60° F. and 30 inches of the barometer, was found to amount to 37·5 cubic centimètres.

To confirm the above result, I placed 6·4790 grms. of the zinc dust at the posterior end of a combustion-tube. A plug of asbestos was then added, and the remainder of the tube was filled up with granular oxide of copper, followed by another plug of asbestos. The rest of the arrangements were precisely as in an ordinary organic analysis. The column of oxide of copper having been brought to redness, the zinc was heated very gradually. At the end of the operation, the whole of the combustion-tube was heated to redness. Finally it was found that the potash-tube was increased by 0·0225 grm.; and that 0·0365 grm. of water had been obtained. A determination of the moisture in 6·4790 grms. of the zinc dust yielded 0·0055 grm. The water obtained on combustion with oxide of copper has consequently to be reduced by this amount. The water yielded by the hydrogen in the zinc amounted, therefore, to 0·0310 grm. Now, assuming that a litre of hydrogen at 60 and 30 inches weighs 0·0846 grm., it is evident that the hydrogen estimated from the water produced on combustion amounted to 40·0 cubic centimetres, or only 2·5 centimètres more than was obtained by direct heating of the zinc dust in the retort. As in combustions with oxide of copper a slight excess of water is almost invariably obtained, the mean of the two observations (38·75) will probably give a very near approximation to the truth. The volume occupied by 6·4790 grms. of zinc dust was obtained by finding the volume of alcohol which it displaced. Alcohol was used in preference to water, to ensure complete wetting of the metal. In this way it was found that 6·4790 grms. occupied exactly 1 cubic centimètre. We may conclude, therefore, that the commercial zinc dust employed by me contained about 39 times its volume of hydrogen. The increase in weight of the potash-tube is equal to 0·0061 grm. of carbon, and was probably due to the accidental presence of traces of organic matter.



The results of these experiments must, I think, induce us to somewhat modify our views as to the origin of the hydrogen in the meteoric iron of Lenarto. My lamented friend Graham,* by the aid of the Sprengel pump, extracted from that well-known meteorite 2·85 times its volume of gas containing 85·68 per cent of hydrogen. As red-hot iron at ordinary atmospheric pressures only absorbs about half its volume of hydrogen, the conclusion has been drawn that the Lenarto meteorite had at some period been exposed to an atmosphere of hydrogen at greater pressure than would be balanced by a column of mercury 30 inches in height. But as the zinc dust contained 39 times its volume of hydrogen, and had never been exposed to an atmosphere of hydrogen, it is, I think, at least probable that the hydrogen absorbed had, in both cases, been originally derived from water. I hope, in the case of the zinc dust, to be able before long to clear up this point. It is a significant fact that zinc dust rapidly rises in temperature on being moistened.—*Journal of Gas Lighting.*

The Rotatory Power of Solutions of Cellulose in Schweitzer's Liquid.—A. Levallois (*Compt Rend.*) does not agree with Béchamp that cellulose in cupric liquids is devoid of rotatory power, and that this power resides in the solvent. He has always obtained considerable rotations with solutions of cellulose and none with the reagent.

A HARMLESS SOLDERING MIXTURE.*

Some time ago, when experimenting with various chemical substances which might possibly be used for soldering the tin cans in which fish, fruit, and vegetables are now so extensively put up, I was led to interrupt my experiments on learning of a mixture which had been suggested for the purpose, which certainly, it seemed to me, satisfied all sanitary requirements, and which was reported to work well in actual practice. As the mixture has recently been patented its composition is no longer a secret, and I am therefore at liberty to state that it consists of *lactic acid* and *glycerine*, the best proportions being one pound of each of these substances with eight pounds of water.

The inventor of the mixture is Mr. C. N. Waite, of Littleton, Mass., but I do not know whether the patent was issued to him or to the Avery Lactate Company. I am informed that the mixture has been tried with success by Messrs. E. T. Cowdry and Co. in canning fish. How many accidents have really resulted in the past from the use of chloride of zinc I do not know, but no one can deny that there is possible danger in its use, and if a harmless substance, such as that mentioned above, can be made to work practically as a substitute, there will be no longer any good excuse for using a dangerous compound.

W. R. N.

THE DETERMINATION OF GRAPHITE IN MINERALS.

By J. B. MACKINTOSH.

In many instances the accurate determination of the amount of graphite present in a rock has proved a rather troublesome problem. The first thought which naturally suggests itself is to burn the graphite and weigh the carbonic acid produced, but in the case of the sample which led me to seek for another method this way could not be employed, for the specimen had been taken from the surface and was covered and penetrated by vegetable growths which could not be entirely removed mechanically. Add to this the fact of the presence of iron pyrites and the probable occurrence of carbonates in the rock, and it will be at once seen that no reliance could be placed on the results obtained by this suggested method.

As the problem thus resolved itself into finding a way by which all interfering substances could be destroyed without affecting the graphite, it at once occurred to me to try the effect of caustic potash. I melted a few pieces of potash in a silver crucible until it had stopped spitting and was in quiet fusion. I then transferred the weighed sample to the crucible, the melted potash in which readily wetted the graphite rock. The mass was then gently heated and occasionally stirred with a piece of silver wire. The heat never need be much above the melting-point of potash, though toward the last I have been in the habit of raising the temperature slightly, to ensure the complete decomposition of the melt. When the decomposition is complete, which can be known by the complete absence of gritty particles, the crucible is cooled and then soaked out in cold water. This is very quickly accomplished, and we then see that we have an insoluble residue of graphite and a flocculent precipitate of lime, magnesia, iron hydrate, &c., while the organic matters have disappeared. The sulphides of iron, &c., have given up their sulphur to the potash, and everything except the graphite has suffered some change. The solution is now filtered through a weighed Gooch crucible, the residue washed a few times with water, and then treated with dilute hydrochloric acid (followed by ammonia to remove any silver taken up from the crucible), which will dissolve all the constituents of the residue except the graphite, and after

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* *Proc. Royal Soc.*, vol. xv., p. 502.

* From an occasional correspondent of the *Sanitary Engineer.*

washing will leave the latter free and in a condition of great purity.

As evidence of the accuracy of the method I subjoin the results I obtained on a sample whose gangue was free from all organic and other impurities, cousisting chiefly of quartz :—

New Method.	Combustion in Oxygen, weighing CO_2.
15·51.	15·54.

It is plain that such a result leaves nothing to be desired for the accuracy of the method, while as regards time and trouble, the advantage lies on the side of the new method. I have completed a determination in less than two hours from the start, and did not hurry myself over it in any degree.

Fine pulverisation of the sample is not essential, and in fact is rather detrimental, as the graphite when fine is more difficult to wash without loss. When operating on a coarse sample more time is necessarily taken, but the resulting graphite shows the manner of occurrence better, whether in scales or in the amorphous form.

In consulting the literature bearing on the subject I cannot find any mention of this method employed as an analytical process ; it has, however, been previously described as a commercial method for the purification of graphite,* and I understand has been tried on a small scale in this country. The method, though inexpensive, yet seems to have been abandoned for some reason, and I am not aware that it is now employed anywhere.

ACTION OF HYDROGEN PEROXIDE UPON CERIUM AND THORIUM OXIDES.

By M. LECOQ DE BOISBAUDRAN.

The recent publication of an investigation relating to the action of oxygenated water upon yttrium, cerium, and thorium oxides, &c., induces the author not to carry out the experiments which he had undertaken in the same direction. The following observations refer merely to the peroxidation of Ce_2O_3 and of ThO_2.

The determination of the oxygen in excess over that contained in the above-mentioned oxides has been conducted in two ways :—

A. The peroxides, recently but completely washed, are put in a mixture of dilute hydrochloric acid, potassium iodide, and carbon disulphide. This latter substance is coloured by the iodine set free, and the comparison of its colour with those of standard solutions of iodine in carbon disulphide shows the quantity of iodine liberated, and consequently the oxygen obtained from the compound under examination.

B. The peroxides are treated with a mixture of dilute hydrochloric acid, potassium iodide, and starch. The determination of the iodine is effected by means of a solution of sodium sulphite.

Cerium.—The solution of cerous sulphate is treated with a slight excess of ammonia, and hydrogen peroxide is added. The mixture is filtered and washed, and the precipitate analysed as just described. The author has obtained quantities of oxygen corresponding to the following formulæ :—By method A, $CeO_{3\cdot05}$: by method B, $CeO_{2\cdot95}$, or a mean of CeO_3, which corresponds to 14·49 per cent of oxygen for peroxidising C_2O_3 (Ce = 141·6). M. Clève finds figures ranging from 13·71 to 14·08 per cent.

The available oxygen in the orange-red precipitates obtained in heat with cerium acetate and oxygenated water is less than that of the precipitates resulting from the simultaneous action of ammonia and oxygenated water.

For the detection of cerium, the method employed consists in supersaturating the solution with an alkaline acetate, and heating moderately after adding oxygenated water. The precipitate, which is at first white in case of a cerous salt, takes an orange-red colour. It happens, however, occasionally with cerous salts that the deposit only takes a pale yellow colour, or even remains perfectly white. This effect is produced especially when after having boiled the salt with hydrochloric acid it is diluted with water, supersaturated with the alkaline acetate, boiled, and let cool before adding the oxygenated water. In this case the precipitate does not redden on heating the liquid moderately, and cerium might be confounded with thorium, an error which is avoided by moistening the deposit with ammonia and adding oxygenated water. The orange-red colouration is then produced with certainty.

A fact which the author has not been able to explain, and to which he has called the attention of M. Clève, is that the white precipitate formed by oxygenated water in cerous acetate does not liberate iodine on the introduction of iodised mixtures : this compound, then, does not seem to contain more oxygen than does C_2O_3 ; but then how does oxygenated water induce its formation ? This phenomenon does not seem due to a reduction of Ce_2O_3 whilst the acetate is boiling, for if, in place of oxygenated water, we put a little starch into the liquid, this is coloured blue on the introduction of the smallest quantity of iodine.

Thorium.—Thorium acetate gives in heat with oxygenated water a white precipitate which gives up oxygen to iodised mixtures. On treating a salt of thorium in the cold with ammonia and hydrogen peroxide the author obtains (taking Th = 234), $ThO_{3\cdot595}$, or $Th_2O_{7\cdot19}$. M. Clève has fouud thorium peroxide slightly poorer in oxygen than Th_2O_7.—*Comptes Rendus.*

COMPOSITION OF THE GASEOUS PRODUCTS OF THE COMBUSTION OF IRON PYRITES (CONTINUED) ; AND THE INFLUENCE OF GLOVER'S TOWER ON THE MANUFACTURE OF SULPHURIC ACID.[1]

By M. SCHEURER-KESTNER.

New analyses of the gases resulting from the combustion of iron pyrites have confirmed the results which the author communicated to the Academy on November 24, 1884 (*Comptes Rendus*, xcix., p. 917). Sulphuric anhydride is rarely absent, at least in the conditions in which the author's experiments have been made, and it reaches sometimes 9 per cent on the total quantity of sulphurous acid produced from the combustion of pyrites. The gases analysed were generated in stage-kilns from smalls from the mines of Saint-Bel (Rhone). The samples were portions of gas collected during times varying from three to nine hours. In the fourteen experiments recorded, the quantity of sulphuric anhydride ranges from 0·0 to 9·3 per cent of the sulphurous acid. The anhydride thus formed quickly becomes hydrated. The moisture of the air which feeds the pyrites kilns, added to that found in the pyrites themselves, is more than sufficient to convert all the anhydride formed into monchydrate. The anhydride is no longer found in the gases when they have traversed the pipes connecting the kilns to the apparatus for condensing and producing sulphuric acid. The Glover tower retains the hydrated acid to which it has given rise, and it lightens in so far the work of the lead chambers. The author asks whether the increase in the productive capacity of the chambers observed by sulphuric acid makers who use Glover's towers is not due, almost exclusively, to the quantity of sulphuric acid which is condensed or formed in the tower. The former experiments of Vorster (*Dingler's Journal*, 1874), the only ones published on the

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* Schlöffel, *Zeitschrift der K.K. geolog. Reichanstalt*, 1866, p. 126.

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subject to his knowledge, seem to establish that very little sulphuric acid is condensed or formed in the tower. Vorster has even found, contrary to the author's observations, that Glover's tower yields less acid than it receives, a part of the acid being volatilised in the tower and passing into the chambers, so that it would become imposible to explain how the addition of a Glover tower to lead chambers should so considerably augment their power of production.

The experiments which the author has undertaken give, on the contrary, the most natural explanation of this fact. During sixteen days the acid flowing from a Glover tower was collected, and that passing into it determined. Of a total production of 96,000 kilos. of sulphuric acid, calculated as monohydrate, the Glover tower furnished 15,152 kilos., or 15·7 per cent.

Another experiment made by the indirect method—*i.e.*, determining the acid condensed in the lead chambers alone, and deducting this quantity from the total yield—gave, for a total production of 48,300 kilos. of monohydrate, 7922 kilos. as produced by the Glover tower, or 16·3 per cent. The two results are therefore concordant, though obtained by different methods.

It is therefore established that the Glover's tower as constructed at the Thann works yields an important fraction of the total production of acid. Further, this proportion represents exactly, as might be foreseen, the increase in the productive capacity of the lead chambers, which at Thann is from 15 to 18 per cent.

Glover's tower furnishes a certain quantity of work which is due especially to the formation of sulphuric anhydride in the pyrites kilns,—anhydride which becomes condensed as hydrate in the acid which feeds the tower. Next there is formed, as Vorster has demonstrated, sulphuric acid by the reaction of the sulphurous acid with the nitrous acid contained in the acid flowing from the Gay-Lussac tower. Lastly, since in the upper part of the Glover tower the gaseous mixture is the same as that in the lead chambers, it is to be supposed that a certain quantity of acid is produced there also. As the quantity of anhydride found in the combustion gases does not exceed 10 per cent on the sulphurous acid, there must necessarily be a production of sulphuric acid in the Glover tower to make up the 18 per cent obtained from it.

To sum up: The effect of the Glover tower is, in addition to other advantages, to augment the capacity of output in the systems provided with it, and this effect is due—(1) to the condensation of the anhydride produced in the kilns; (2) to the reaction of the sulphurous acid upon the small quantity of nitrous acid gas which it there encounters; (3) to the known reaction of the chamber gases which begins in the Glover tower.—*Comptes Rendus.*

PROCEEDINGS OF SOCIETIES.

CHEMICAL SOCIETY.

Ordinary Meeting, Thursday, March 19, 1885.

Dr. W. H. PERKIN, F.R.S., President, in the Chair.

MESSRS. C. J. Baker, H. Brereton Baker, and George Patterson were formally admitted Fellows of the Society.

Certificates were read for the first time in favour of Messrs. Harold Follows, The Hough, Stafford; Harry M. Freear, 40, Osborne Road, Tollington Park, N.; F. A. Genth, jun., 4014, Chesnut Street W., Philadelphia, U.S.A.; G. M. Gregory, Gazipur, N.W.P. India; and William Hamilton Reid, 20, Wharf Street, Stockton-on-Tees.

ADDENDUM TO DISCUSSION on Paper No. 18.

Dr. DEBUS wishes to have pointed out that the statement attributed to him that "after all, such questions were very much matters of opinion" is based on a misunderstanding of his remarks; that he certainly does not hold the views which can be deduced from such a statement, as chemical research in our days is carried on by the majority of chemists—perhaps 99 in 100—on the assumption that the mode of combination of atoms in molecules can be made out. He only differs from Dr. Divers in one point: in not considering the experiments of Dr. Divers as sufficient evidence that the metal in nitrites is in direct combination with nitrogen. We must conclude from the formation from silver nitrite of nitroethane together with ethyl nitrite, that silver nitrite is a mixture of two salts; but silver nitrite and methyl iodide yield only nitromethane.

The following papers were read:—

21. "*On the Presence of Choline on Hops.*" By Dr. GRIESS, F.R.S., and Dr. G. H. HARROW.

The authors have separated choline,—

$$C_2H_4(OH).NMe_3.OH,$$

from hops by adding to a concentrated extract, acidified with chlorhydric acid, a solution of iodine in iodhydric acid. The semi-solid precipitate obtained—a choline periodide—was boiled with water to expel iodine, and the resulting solution of choline iodide treated with silver oxide; the impure choline in the solution was then converted into the auro-chloride, which was re-crystallised. In this manner they have not been able to obtain more than 1·50th per cent of choline from hops. They consider it not improbable that it exists in loose combination with resin, as they find that a very dilute aqueous solution is capable of dissolving comparatively large quantities of hop resin, the liquid being then of intensely bitter taste. Employing the same method, they have also extracted choline from beer.

22. "*Fluorene.*" Part III. By Dr. W. R. HODGKINSON.

In two previous notes to the Society the author has remarked upon, and given examples of, the facility with which fluorene and its derivatives condense to a double molecule, owing to the presence of the CH_2 group. This action takes place when fluorene is heated to a high temperature alone or in contact with even very gentle oxidising agents. In a previous note two isomeric difluorenes were described, which were obtained from the red body produced when fluorene is passed over red-hot manganese dioxide. At that time the red body was distilled under reduced pressure, as the red colour could not be removed by crystallisation, and the distillate was then crystallised from acetic acid. It has since been found that the hydrocarbon, $C_{26}H_{18}$ (melting at 246°), termed *para-difluoryl*, suffers considerable, if not complete, decomposition even when distilled under reduced pressure. However, by distilling the crude product only so far as to separate the main bulk of unaltered fluorene, and treating the highly-coloured residue with cooled ether—which dissolves the red colouring matter and any unchanged fluorene—a very slightly coloured residue of the $C_{26}H_{18}$ hydrocarbons is obtained. The crude product forms about 10 per cent of the original fluorene, and contains at least three isomers of the formula $C_{26}H_{18}$. The one present in greatest quantity, and the only one as yet examined, is that melting at 246°. This body forms long prisms, very slightly soluble in cold ether or chloroform, and only moderately in hot acetic acid. On slightly heating it above its melting-point it decomposes, forming another hydrocarbon of lower melting-point, and a large amount of carbonaceous matter. It is not easily brominated; a cold solution in $CHCl_3$ may be treated with bromine without much action taking place, and, when heated, a tetrabromo-compound, extremely insoluble in all solvents, is formed, which melts, with decomposition, at about 302°. On boiling it with fuming nitric, a dinitro-compound is formed. It is not very easily oxidised; the acetic solution requires to be boiled with a large excess of CrO_3. The product crystallises from acetic acid in very fine rhombs, melting at 255°, and sublimes unchanged. It has the composition $C_{26}H_{14}O_2$, and is probably an oxide, not a quinone. Alkalies, bromine, or nitric acid scarcely affect it.

The di-haloid derivatives of fluorene, as mentioned in the author's previous note, contrary to statements by Van Dorp and others, are readily acted upon by alkalies, halogen being removed and difluorene compounds formed: with fused or concentrated potash the action is violent, and pure products are not easily obtained. The action of alcoholic potash is more manageable, but the best result is obtained by the action of sodium ethoxide. On dissolving $C_{13}H_8Br_2$ in alcohol, and adding sodium, a green solution is formed; on dilution with water and boiling, this deposits a brilliant red crystalline powder, which is exceedingly insoluble. Analysis shows it to have the composition $C_{26}H_{14}Br_2O$. This body crystallises from boiling cumene or acetic anhydride in red microscopic prisms, melting above 360°; the chloro-derivative is analogous.

It appeared possible that this body might be produced by the simultaneous action of bromine and potash on fluorene; it was found, however, that the main product is monobromofluorene, identical with that already described, melting at 103° to 104°; this is an excellent way of making the mono-haloid derivatives of fluorene, as in the ordinary way much di haloid derivative is always formed. Sodium ethoxide acts on monobromofluorene; the product is of a yellow colour and free from bromine.

A mononitrofluorene is obtained by very careful addition of the calculated amount of nitric acid to a cooled solution of fluorene in acetic acid: it forms small prisms, very soluble in hot alcohol, and melts at 151°. The amido-compound from it is rather unstable. On heating nitrofluorene above its melting-point it decomposes, one product being a $C_{26}H_{10}$ hydrocarbon that is not identical with any of those directly obtained from fluorene.

23. "*Combustion in Dried Gases.*" By H. BRERETON BAKER, B.A.

Led by Mr. Dixon's experiments, the author has investigated the question whether moisture is necessary for the combustion of carbon and phosphorus in oxygen. The phosphorus used (commercial amorphous phosphorus) had been washed with water and dried at 100° in a current of carbon dioxide, previously passed through two wash-bottles of sulphuric acid; it was then heated in a Sprengel vacuum, at 150° to 160°. The carbon (finely powdered charcoal) had been heated to bright redness in a current of dried chlorine for three hours; the tube containing it was then transferred to an air-bath and heated at 200° while a current of dried air was passed through it. Portions (0·5—1 grm.) were sealed up in bent hard glass tubes along with phosphoric oxide, the tube being filled with oxygen prior to sealing. To free the glass from adhering moisture, the ends of the tubes containing the carbon or phosphorus were heated in an air-bath at 130° to 150°, the other ends being kept cool. After about eight days, the tube containing phosphorus and dried oxygen and another similar tube with phosphorus in oxygen saturated with water were supported at the same height above the flame of an Argand burner: the phosphorus in the wet gas soon took fire, but that in the dried gas slowly distilled and formed a red and yellow deposit on the cooler part of the tube. A similar pair of tubes containing carbon was placed over the large flame of a Bunsen burner: the moist carbon burnt with bright scintillating flashes, but no apparent combustion took place in the tube containing dried gas, though it was heated to bright redness for several minutes.

A series of such experiments with carbon, in which the drying extended over various periods, were then made, the gaseous contents of the tubes being analysed after the tubes were heated. The results obtained clearly show that the burning of carbon is much retarded by drying the oxygen to the extent which is possible with the arrangement adopted by the author.

	Wet.	Dried 1 week.	Wet.	Dried 2 weeks.	Wet.	Dried 4 weeks.
CO_2 ..	50·1	15·4	51·0	19·0	45·3	14·1
CO ..	22·2	20·6	31·2	14·8	32·5	27·8
O_2 ..	—	41·3	—	46·1	—	28·2
N_2 ..	27·6	22·6	17·7	20·0	22·1	29·8

	Wet.	Dried 8 weeks.	Wet.	Dried 12 weeks.	Wet.	Dried 16 weeks.
CO_2 ..	23·3	12·5	58 8	15·8	52·4	17·8
CO ..	60·0	27·5	23·2	24·2	25·2	16·5
O_2 ..	—	39·0	—	33·3	—	45·0
N_2 ..	16·6	21·0	17·9	26·6	22·3	20·6

Other forms of the experiment were described, which led to similar results.

The author successfully made an experiment before the Society with two tubes, the one containing dried, the other undried, oxygen and carbon.

DISCUSSION.

Referring to Mr. Cowper's experiments, Dr. DEBUS said that the fact that Dutch metal did not take fire in dry chlorine might be due to the formation of a protecting layer of chloride; if water were present, this would become dissolved. Such an explanation, however, cannot hold good for gases.

He described some experiments made at his suggestion by Mr. Cowper with a view to test some of the conclusions arrived at by Mr. Dixon in his research on the explosion of mixtures of carbonic oxide and oxygen.

The heat of combustion of carbonic oxide at 18°, according to Thomsen, is 67,960 units; the heat of formation of water-vapour at 100° is 58,069 units, and accordingly at 18° it is 58,778 units; hence the thermal change involved in the burning of carbonic oxide at the expense of the oxygen of water is 67,960 − 58,778 = 9182 units.

Therefore, it appears theoretically more probable that the carbonic oxide of a mixture of carbonic oxide, oxygen, and moisture will, during combustion, combine with free oxygen rather than with the oxygen of the aqueous vapour.

Mr. Cowper's experiments, however, confirm Mr. Dixon's statement that a mixture of dry carbonic oxide and oxygen is not exploded by the passage of electric sparks, but he observed that a slow and partial combination of the gases takes place, probably caused by the high temperature of the platinum wires between which the sparks were produced. Mr. Baker has shown that the combustion of dry charcoal in dry oxygen is incomplete and much slower than in ordinary moist oxygen. Hence, moisture appears to play in the combustion of solids the same part as it does in that of gases. Mixtures of hydrogen and oxygen, however dry, always exploded.

Dr. ARMSTRONG regarded Mr. Baker's paper as an important addition to our knowledge. By facts such as those adduced, chemists must ere long be led to form a definite conception of the nature of chemical action and of the conditions under which chemical action could take place. It was well known that iron did *not* rust in oxygen; that zinc did *not* dissolve in diluted sulphuric acid; that chlorine did *not* affect sodium. These facts had led him a good many years ago to come to the conclusion in his own mind that probably chemical action did not take place between *two* substances, and numerous facts which had since come to light had only served to strengthen this conviction: for example, those afforded by Mr. Cowper's observations on the behaviour of metals in dry chlorine, and by Mr. Dixon's refined study of the conditions under which carbonic oxide explodes. He had even ventured to affirm to Mr. Dixon that some day it would be ascertained that a mixture of pure oxygen with pure hydrogen was not explosive. It should be pointed out, however, that although chemists had failed to formulate any definite conception regarding chemical action, physicists had already pointed out that the amount of chemical action that could occur between *two* substances was practically *nil*, this having been stated in so many words by Ayrton and Perry in their paper on the "Contact Theory of Voltaic Action" (*Proc. Roy. Soc.*, 1878, 27, 196). Dr. Armstrong said that the view which he now held was best stated by defining chemical action as *reversed electrolysis*, *i.e.*, in any case in which chemical action was to take place, it was essential that the system operated upon should contain a material of the nature of an electrolyte. Neither oxygen nor hydrogen was an electrolyte, therefore a mixture of only these two gases should not be explosive; a mixture of pure oxygen and pure carbonic oxide for like reasons should not explode. There was, however, a tendency perhaps to exaggerate the importance of water, and to overlook the possible presence in minute quantity and influence of other bodies. Water not being an electrolyte, as it was scarcely probable that water and oxygen or hydrogen would form an electrolyte, it was difficult to understand that the presence of water pure and simple should be of influence in the case of a mixture of oxygen and hydrogen. It was, perhaps, necessary to distinguish two kinds—or degrees—of chemical action: that taking place at moderate, and that taking place at high temperatures. It may be that on passing sparks in a mixture consisting only of carbonic oxide and oxygen, oxidation takes place in the path of the sparks but is not propagated throughout the mass—*i.e.*, there is no explosition—on account of the excessive resistance. ["To connect the two ideas (of chemical affinity and the amount of chemical action) we have a third, viz., resistance, and the electrical law of Ohm becomes the chemical law—the quantity of chemical action in unit time equals the sum of a great number of terms, each of which is an electromotive force divided by a resistance."—Ayrton and Perry, *loc. cit.*]

Dr. ALDER WRIGHT remarked that the appearance described by Dr. Debus (as observed by Mr. Cowper in his repetition of Mr. Dixon's experiment with dried carbonic oxide and oxygen) of a slight amount of blue flame in the vicinity of the platinum wires, indicating a small amount of chemical action not propagated throughout the whole mass, appeared to him to be connected with the fact that a stream of purified CO (not dried), issuing from a gas-holder with more than a certain limiting velocity, will not burn with a continuous flame, but blows itself out, the velocity of propagation of chemical action in the mixture of CO and air formed at the orifice from which the CO issues in the outer portion of the stream, being less than the onward velocity of the moving stream. It would be of interest to determine the limiting velocity at which the gas would just cease to burn for different degrees of dryness, and the influence of such conditions as temperature and pressure upon the velocity: or mixtures of CO and O_2 might be burnt (from a safety jet) with varying speeds of delivery and of various degrees of dryness. With reference to the views of Dr. Armstrong respecting the intimate connection between chemical action and electrical phenomena, it might be of interest to recall the fact that in 1841 and subsequent years, Dr. J. P. Joule put forth this creed (in a series of papers in the *Phil. Mag.*), that the development of heat in combustion and analogous chemical phenomena resulting in the formation of electrolytes is simply a consequence of resistance to electric conduction between the particles of the bodies undergoing change, so that the heat evolved in such actions is proportional to the electromotive force of the current passing between the particles. This view and the consideration of later valuations of certain heats of chemical change was subsequently (1851) expanded by Sir W. Thomson in his well known paper on the "Mechanical Theory of Electrolysis," in which it was shown that the actual electromotive force generated by a Daniell cell was directly calculable in absolute units from the heat development brought about in virtue of the sum of the chemical changes taking place in the cell whilst in action; and although subsequent investigations have shown that with certain kinds of voltaic combinations the agreement between the observed and calculated electromotive force is not as close as with the Daniell cell, yet on the whole it may fairly be regarded now as distinctly proved that the possibility of the occurence of chemical change, and the way in which it takes place, are most intimately associated with certain of the electrical qualities of the bodies brought together.

Mr. CROOKES said that in making incandescent lamps he had noticed some facts of interest in connection with the paper. During exhaustion, the filament was heated first to a moderate extent in carbon tetrachloride vapour, and afterwards, when a very high exhaustion was attained, to a very high temperature. Lamps thus prepared had been found sometimes to last in use for a great many hours, even when some oxygen was present in the bulbs; but at other times they very soon broke down: at last it was discovered that in the latter case the phosphoric oxide in the drying tubes attached to the pump had deliquesced. It was practically impossible to dry gases with sulphuric acid, and it was almost as difficult to do so with phosphoric oxide; he had only succeeded by passing the gas through 6 feet of combustion tubing, into which phosphoric oxide had been tightly packed.

Mr. VERNON HARCOURT said that oxygen inclosed with phosphoric oxide for many days would probably become as nearly dry as oxygen passed through a long tube tightly packed with the same substance. Mr. Dixon had found that the inflammation of a mixture of oxygen and carbonic oxide depended upon the pressure and temperature to which the gases were subjected, as well as upon the proportion of steam mixed with them. A nearly dry mixture, uninflammable by the electric spark under a pressure of half an atmosphere, might be inflamed by a stream of sparks or under a greater pressure. A mixture of hydrogen and oxygen could be inflamed by the electric spark only at a certain tension, and this tension was the same whether steam were present or, as far as possible, absent. Perhaps in this case also some third substance was present. The action of steam was not likely to be exceptional. Mr. Baker seems to have established the conclusion which he had expressed with proper caution, that the combination of carbon and oxygen is affected by the presence of steam.

The Anniversary meeting will be held on Monday, March 30th, at 8 o'clock.

(The 31st has been incorrectly announced on the balloting papers).

UNIVERSITY COLLEGE, LONDON,

CHEMICAL AND PHYSICAL SOCIETY.

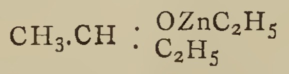
Thursday, March 19, 1885.

DR. H. FORSTER MORLEY, Vice-President, in the Chair.

MR. A. G. GREEN, F.C.S., read a paper on "*The Various Modes of Action of Zinc Ethyl and its Homologues on Organic Compounds.*" In reviewing the literature of the subject he found that its reactions may be summarised under the following different headings:—

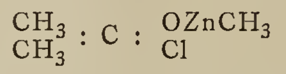
I. Simple replacement of halogens by $-C_2H_5$, as, for instance, in the action of $ZnEt_2$ on bichlor-ether, forming $C_2H_5.O.C_2H_3(C_2H_5)_2$. (Lieben, *Ann.*, cxli., 236; cxlvi., 180). See also—Gal, *Ann.*, cxlvii., 126. Hessel, *Ann.*, clxxv., 44. Frankland and Graham, *J. Chem. Soc.*, 1880, 740. Frankland and Louis, *J. Chem. Soc.*, 1880, 742.

II. Addition to a CO group, as for example the action on aldehyd (Wagner, *Ann.*, clxxxi., 261), forming the compound—



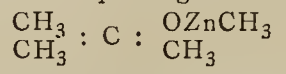
$$CH_3.CH : \begin{matrix} OZnC_2H_5 \\ C_2H_5 \end{matrix}$$

which, on treatment with water, gives ZnO,C_2H_6 and ethyl-methyl-carbinol, Reactions I. and II. probably occur consecutively when $ZnEt_2$ acts on acid chlorides (Pawlow, *Ann.*, clxxxviii., 104); thus, with acetyl chloride and zinc methyl, the compound



$$\begin{array}{l}CH_3\\CH_3\end{array} : C : \begin{array}{l}OZnCH_3\\Cl\end{array}$$

is first formed (which on treatment with water gives acetone), and by a more prolonged reaction the body

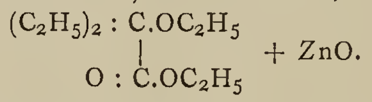


$$\begin{array}{l}CH_3\\CH_3\end{array} : C : \begin{array}{l}OZnCH_3\\CH_3\end{array}$$

is produced, giving, on treatment with water, trimethylcarbinol. See also—Popoff, *Kasan*, 1869. Freund, *Ann.*, cxviii., 1. Butlerow, *Zeitschrift*, 1863, 484; 1864, 385; 1865, 614.

III. In the above reactions it can produce isomeric changes; thus Butlerow and Ossokin (*Ann.*, cxliv., 43; cxlv., 259), have shown that by the action of $ZnEt_2$ on ethylene iodhydrin ($CH_2I.CH_2OH$) the secondary butyl alcohol ($CH_3.CH(OH).C_2H_5$) is produced, instead of the primary ($C_2H_5.CH_2.CH_2.OH$). For further researches on these changes see—Winogradow, *Ann.*, cxci., 125. Kashirsky, *Ber.*, x., 407: xi., 986. Bogomolez, *Ann.*, ccix., 70. See also—Tcherbakow, *Ber.*, xiii., 2405; and *Ber.*, ix., 33, 77, 1601; xi., 1939, 2153.

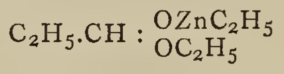
IV. Replacement of $=O$ by $=(C_2H_5)_2$, as in the action of $ZnEt_2$ (or zinc and EtI) on oxalic ether, forming



$$\begin{array}{l}(C_2H_5)_2 : C.OC_2H_5\\ \qquad\qquad\;\; | \\ \qquad\;\; O : C.OC_2H_5\end{array} + ZnO.$$

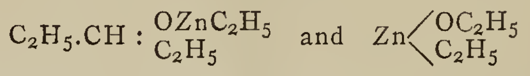
(Frankland and Duppa, *Ann.*, cxxxv, 25; cxlii., 1.)

V. Replacement of $-OC_2H_5$ by $-C_2H_5$, as in the action of $ZnEt_2$ on formic ether, the compound first produced—



$$C_2H_5.CH : \begin{array}{l}OZnC_2H_5\\OC_2H_5\end{array}$$

giving

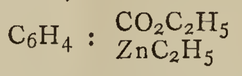


$$C_2H_5.CH : \begin{array}{l}OZnC_2H_5\\C_2H_5\end{array} \quad \text{and} \quad Zn\begin{array}{l}\diagup OC_2H_5\\ \diagdown C_2H_5\end{array}$$

which by treatment with water produces diethyl-carbinol. (Wagner and Saytzeff, *Ann.*, clxxv., 351). See also—Kannonnikoff and Saytzeff, *Ann.*, clxxv., 374. Frankland and Duppa, above references. Claus, *Ann.*, cxli., 228.

VI. To a $=CO$ group it can add on $-ZnC_2H_5$ and $-H$ with evolution of C_2H_4 (Garzorolli-Thurnlackh, *Ann.*, ccx., 63; ccxiii., 369; ccxxiii., 149, 166). Thus $ZnEt_2$ produces with chloral the compound $CCl_3.CH_2.OZnC_2H_5$, which by the action of water gives trichlor-ethyl alcohol. $ZnMe_2$, however, acts normally since CH_2 cannot exist.

VII. It can replace $-Cl$ by $-ZnC_2H_5$, forming as correlative product C_2H_5Cl. Thus chlorbenzoic ether is reduced to benzoic ether;

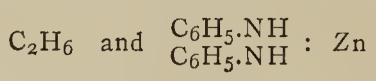


$$C_6H_4 : \begin{array}{l}CO_2C_2H_5\\ZnC_2H_5\end{array}$$

being probably formed as the intermediate product. See also—Tscherbakoff, *Ber.*, xiii., 2405. Winogradow, *Ann.*, cxci., 125.

VIII. Replacement of the H of an $-OH$ group by $-ZnC_2H_5$, evolving C_2H_6. Thus methyl alcohol and $ZnMe_2$ gives $CH_3.OZnCH_3$. See Butlerow, *Jahrsb.*, 1864, 467. Ladenburg, *Ann.*, clxxiii., 148.

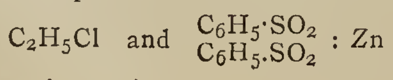
IX. Replacement of the two H atoms in two mols. of an amido compound by Zn. Thus $ZnEt_2$ and aniline form—



$$C_2H_6 \quad \text{and} \quad \begin{array}{l}C_6H_5.NH\\C_6H_5.NH\end{array} : Zn$$

(Frankland, *Proc. Roy. Soc.*, viii., 502.)

X. Replacement of the two Cl atoms in two mols. of a sulphuric chloride by Zn. Thus $ZnEt_2$ and benzene sulphonic chloride produce—

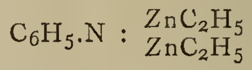


$$C_2H_5Cl \quad \text{and} \quad \begin{array}{l}C_6H_5.SO_2\\C_6H_5.SO_2\end{array} : Zn$$

(Kalle, *Ann.*, cxix., 153).

XI. In a compound containing a $=CO$ group and a halogen, it may first add itself to the $=CO$ and then split off ZnC_2H_5Cl, with the halogen, producing an oxide. (Morley and Green, Chem. News, li., 46; *Journ. Chem. Soc.*, 1885, 134.

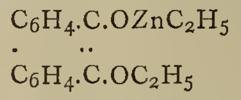
XII. It can split a diazo-compound, adding $=(ZnEt)_2$ to each N and evolving C_2H_6 and C_2H_4. Thus Frankland and Louis (*Journ. Chem. Soc.*, 1880, 560) obtained from azobenzene the compound—



$$C_6H_5.N : \begin{array}{l}ZnC_2H_5\\ZnC_2H_5\end{array}$$

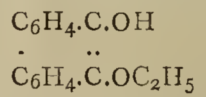
giving aniline on treatment with water.

XIII. It forms an addition-product with a quinone. Thus from phenanthraquinone Japp obtained the compound—



$$\begin{array}{l}C_6H_4.C.OZnC_2H_5\\ \;\;\cdot\quad\;\; \cdot\cdot\\C_6H_4.C.OC_2H_5\end{array}$$

which on treatment with water gave—



$$\begin{array}{l}C_6H_4.C.OH\\ \;\;\cdot\quad\;\; \cdot\cdot\\C_6H_4.C.OC_2H_5\end{array}$$

(*Journ. Chem. Soc.*1879, 526; 1880, 408).

XIV. It can simply act as a dehydrating agent in the same way as $ZnCl_2$. Thus, by the action of $ZnEt_2$ on acetone, Pawlow (*Ann.*, clxxxviii., 104) found that mesityl oxide and phorone are produced.

XV. It can act as a polymerising agent, as in the formation of cyaphenine, $(C_7H_5N)_3$, from benzonitrile (C_7H_5N). (Frankland and Evans, *Journ. Chem. Soc.*, 1880, 563. Frankland and Tompkins, *Journ. Chem. Soc.*, 1880, 566).

A Paper was next read by Mr. C. A. Schunk, upon the "*Quantitative Investigation of the Absorption Spectrum of the Blue Potassium Chromium Oxalate.*"

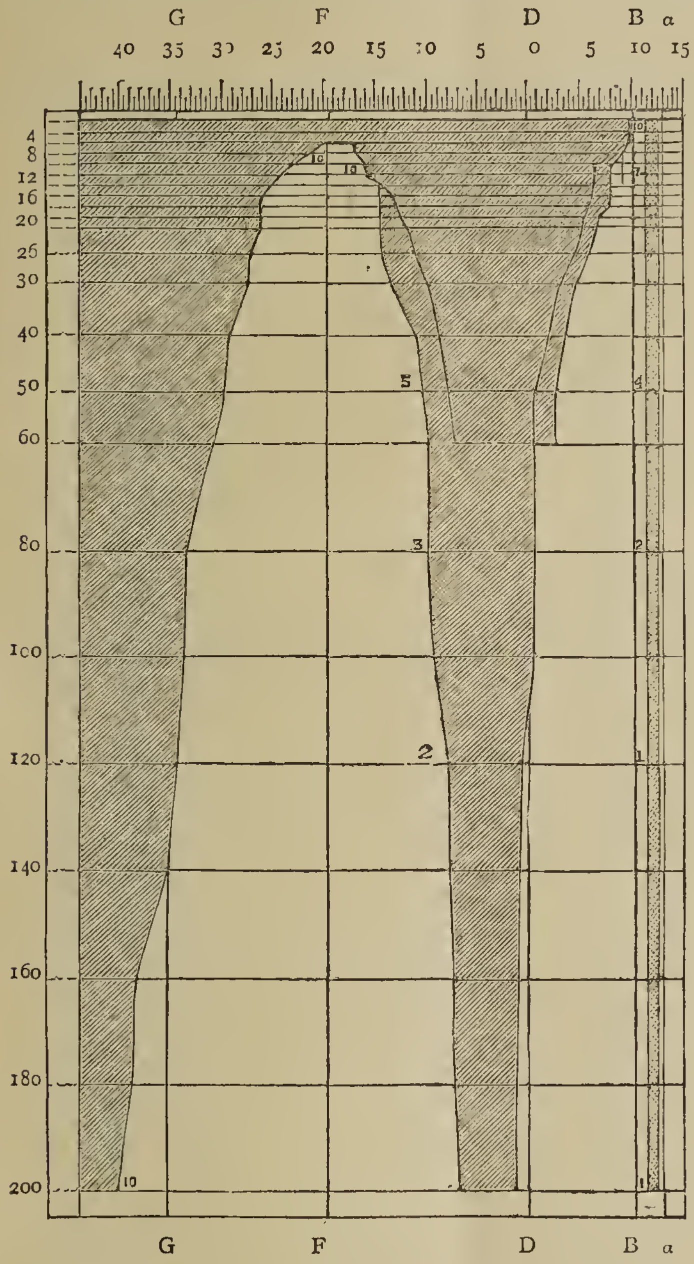
The observations were made on a column of a solution of the salt, 1 c.m. in thickness, in a glass cell having parallel sides. Twenty-three different experiments were made with solutions varying in strength from 2 to 200 parts of water to 1 part of salt, and from them the absorption curve was drawn.

The most characteristic spectrum is obtained when the strength of solution is 16 to 1: it is characterised by two bands, one in the red, and the other in the green and yellow. The one in the red is the narrow band observed by Brewster; it is situated between the solar lines B and *a*. In concentrated solutions its edges are exceedingly well defined, and its intensity is equal to that of total obscuration; but at the particular strength named it has about half this intensity, and its edges are moderately sharp. The other band lies between the solar lines C and *b*; it is thus much broader than the former, but its edges are not so well defined. In this strength of solution, also, part of the violet is cut off.

A saturated solution (4 sol.) has the narrow band only visible, and it is then at its best, and on the more refrangible side beyond the line B the whole of the spectrum is obscured.

The band in the green and yellow is not visible until the solution has a strength of 6 to 1. When it first appears its intensity is equal to that of total obscuration and its edges are well defined, but on further dilution it soon loses its definite character, and its edges become very ill-defined. From 6 sol. to 60 sol., on the less refrangible side of the band in the green and yellow, there is a distinct shading at the side of the band, and on the more refrangible side, from 14 sol. to 60 sol., there is also shading (see Curve). From 120 sol. to 200 sol. not much change takes place in the bands; they gradually become less distinct, but their breadth does not vary much much; but the chief change is that the whole spectrum is brighter. With a solution of strength 200 to 1 the bands are hardly visible, and none of the violet is cut off; but at this point there is still a good deal of light absorbed throughout the whole spectrum.

The instrument used was one of Hilger's table spectroscopes, having a prism of light flint-glass, which only just divided the sodium lines at the angle of minimum deviation: the light used was an ordinary paraffin lamp with a duplex burner.



The numbers on the left-hand side denote the strength of solution in n parts of water to one of salt. The numbers at the sides of the curve denote approximately the relative intensities of the different parts of the curve, that of total obscuration being taken as "10," the intensities being estimated from "1" to "10." The curve on the right-hand side of the broad band represents shading; it stops at concentration 60 to 1. The curve on the left-hand side also denotes shading, but at 60 to 1 the main part of the band and the shading are of the same intensity, as is shown in the diagram.

In this diagram the abscissæ represent the arbitrary scale of the instrument, the Fraunhofer lines, G, F, D, B, and α, being drawn across the diagram. The ordinates represent the number of parts of water containing one part of the salt.

Samuel Rideal, *Hon. Sec.*

RUSSIAN PHYSICO-CHEMICAL SOCIETY.

Chemical Section.

December 13/25, 1884.

The President, Prof. D. Mendeleiff, in the Chair.

Prof. N. Menshutkin read a paper on the "*Isomerism of Hydrocarbons according to the Theory of Substitution.*"

D. Konovaloff read a paper sent in by J. Bevan on the "*Precipitation of the Carbonates of Alkaline Earths by Alkaline Carbonates.*"

N. Sokoloff presented the results of his Investigations of the Water of the Neva during 1883—84; the variations in the quantities of dry residue, its mineral and organic substance were examined; on comparing the curves serving for the expression of these variations in the mean mensual quantities with the curve of the average monthly temperatures, it was stated that the form of the latter is the inverse of the curve of mineral substance, and corresponded to the curve of organic substance. A comparison with the curve of dry residue, given by Tidy (*Journ. Chem. Soc. Transact.*, 1880, 270), for the Thames, shows the curves for both rivers to be of an identical character, a fact the more remarkable as the origin of the Neva is quite different from that of the Thames.

V. Alexeieff communicated a paper on the "*Isomerism of Solutions.*" The existence of a "point of transition" (Van t'Hoff) in these phenomena can only be explained by admitting that bodies may be dissolved either remaining in the solid state, or previously melting.

D. Pavlov gave an account of the following investigations begun in the laboratory of the S. Vladimir-University, Kieff:—

M. Dospiekhov has studied the products of reduction of nitrocumene, the cumene being prepared by Gustavson's method. He has succeeded in obtaining azocumene, a yellow crystalline substance; it melts at 112—113°, and, on further heating, evaporates, and hydro-azocumene, a colourless substance, melting at 65°

N. Volodkievitch has obtained, by heating β-naphthylamine with oxide of lead, a substance apparently identical with azo-naphthaline. Further work will be directed to elucidate the question whether the latter belongs to the α- or the β-groups.

D. Pavloff read a paper of P. Alexeiff on the "*Action of Light on Nitrocuminic Acid.*"

The same author read a remark of E. Wroblevsky on the "*Action of Alcohol on Diazo-compounds.*"

G. Wachtel made a communication on the "*Manufacture of Potassium Dichromate.*"

L. Gorboff and A. Kessler demonstrated an apparatus for fractional distillation under diminished pressure.

D. Pavloff communicated a remark of J. Barzilovsky on the "*Oxidation of Aromatic Amines.*"

January 3/15, 1885.

The President, Prof. D. Mendeleiff, in the Chair.

Prof. A. Butlerow presented some remarks on a paper read at the December meeting by Prof. N. Menshutkin on "The Isomerism of Hydrocarbons according to the Theory of Substitution.

G. Gustavson communicated "*Thermic Data for the Compounds of Aluminium Bromide with Hydrocarbons.*" The numbers found on determining the heats of solution of aluminium bromide and of its compound with toluene prove the formation of the latter to be accompanied by evolution of heat.

G. Struve gave an account of an instance of chemico-legal examination of a forged document.

V. Pavlov communicated a paper on "*Tetric Acid, the Products of its Dry Distillation with Lime, and of the Action of Phosphorus Pentachloride upon the Acid.*" In the former reaction, amongst others, methyl-ethyl-ketone is formed, the acid yielding a substance with four carbon atoms, after the splitting off of carbon dioxide.

M. Chéchoukov made a communication on "*The Separation of Butylenes obtained by Puchot's Method.*"

V. Alexeieff read a paper on "*The Vapour-Tension of Solutions;*" the relation between the composition, the tension, and other properties of the vapours of mixtures of liquids that do not combine at all, as well as those forming more or less definite compounds, special attention being paid to vapours of liquids which upwards from a given tempeeature acquire the property of mixing in every proportion.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

NOTE.—All degrees of temperature are Centigrade unless otherwise expressed.

Comptes Rendus Hebdomadaires des Séances, del'Académie des Sciences. Vol. c., No. 8, February 23, 1885.

This number gives an account of the Annual Public Session of the Academy, and comprises the Presidential Address of M. Rolland—in which there is nothing novel, either as fact or as generalisation—and the awards of the numerous prizes at the disposal of Academy.

The "grand prix" of the mathematical sciences, for improvement in some important point of the theory of the application of electricity to the transmission of work, has not been awarded, and is postponed to 1886. A sum of 1000 francs has, however, been voted by way of encouragement to M. Cabanellas, the author of the only memoir which had been sent in.

The "Jecker" prize has been awarded to M. Chancel for his researches on the acetones, the aldehyds, the nitro-products of the acetones, the mixed ethers formed by the bibasic acids, those of two different alcohols, and also for the discovery of propionic alcohol, the next superior homologue of ordinary alcohol.

The Montyon prize for improvements concerning the insalubrious arts has not been awarded, but an encouragement of 1500 francs has been assigned to M. Marsant for an improved safety-lamp.

The Ponti prize has been awarded to M. Joseph Boussingault for having demonstrated that the complete fermentation of a given weight of sugar dissolved in water can be effected only if the alcohol produced is separated from the fermenting liquid progressively as it is formed.

Among the prizes offered for the present year, and for 1886, 1887, and 1895, we mention the medal of the value of 3000 francs offered for some important improvement in the theory of the electric transmission of work. The memoirs must be sent in to the Secretary of the Academy before June 1st, 1886, bearing a motto, and accompanied by a sealed paper marked with the same motto and containing the name and address of the author.

Memoirs for the Bordin prize of 3000 francs, "On the Origin of Atmospheric Electricity, and the Causes of the Great Development of Electric Phenomena in Storm Clouds," may be sent in up to June 1st next.

The three Lacaze prizes of 10,000 francs each for the researches which shall have contributed most to the progress of physics, chemistry, and physiology will be awarded at the next annual meeting.

The Jecker prize of 10,000 francs for the most important grogress in organic chemistry will in future be awarded annually.

Bulletin de la Société Chimique de Paris.
Vol. xliii., No. 4, February 20, 1885.

Notice of the Researches of M. Dessaignes, Ex-Member of the Council of the Society.—M. Berthelot. Of merely historical interest.

On Bromine Substitutions.—MM. Berthelot and Werner.—An examination of tri-, di-, and mono-bromphenol.

Three New Compounds of Iridium.—C. Vincent.—Already noticed.

Action of Hydrogen Peroxide upon the Phenols.—M. Martinon.—If we add hydrogen peroxide to a mixture of the aqueous solutions of phenol and of a ferric or ferrous salt, there is set up a brisk reaction with a considerable rise of temperature; at the same time the liquid becomes turbid and takes a blackish-brown colour. For the reaction to begin in the cold the solution of oxygenated water must be slightly acid. On adding to such a solution little by little a mixture of phenol and a ferric salt, the mixture containing no more excess of acid than may be derived from the ferric salt, there is first produced a green colouration. This colour is very distinct, even with a few drops of oxygenated water diluted to 1-10th. A larger quantity gives a black precipitate and a black liquid; in presence of an excess both precipitate and liquid turn to a brown, and lastly the precipitate dissolves, leaving merely a liquid with a slight orange-brown tint. The relative quantities of iron contained in the mixture also produce variations in the shade and the intensity of the precipitate. A small quantity of iron gives a slight precipitate of a maroon black, whilst, with a larger quantity the precipitate is blue-black. When the acidity of the liquid is sufficient to hinder the reaction from being produced in the cold, a large excess of iron makes it begin immediately. All the precipitates thus formed contain different proportions of iron, varying, after a prolonged washing with acidulated water, from 3 to 9 per cent. These bodies are extremely soluble in water and still more in alcohol. They dissolve also in strong sulphuric acid, and the sulphuric solution, if thrown into cold water, leaves the substance in the form of a black precipitate still containing 2 to 3 per cent ferric oxide. These substances are very soluble in the alkalies, which do not precipitate the oxide of iron. Nitric acid attacks them briskly, and the yellowish brown product is very soluble in water and in alkalies. We may substitute copper for iron in the above mixture. The reaction is produced easily but with a less liberation of heat. The other metals, except vanadium, produce no reaction. Resorcine gives analogous reactions to those of phenol, but less easily and completely. All the compounds thus formed are very permanent against the atmosphere and other agents, and may be utilised for obtaining fast shades in calico-printing. When ordinary phenol is employed the principal product is the oxyphenic acid.

The Leucomaines: Alkaloids derived from the Albumenoids.—A. Gautier.—This is a memoir on the ptomaines, which the author unhappily wishes to re-name.

Researches on Samarium.—P. T. Cleve.—See page 145.

Contribution to the Study of the Alkaloids.—M. Oeschsner de Coninck.—In this preliminary notice the author tabulates the reactions of α-picoline, γ-lutidine, pyridine, ordinary piperidine, and synthetic piperidine.

Supplementary Number.

This issue consists of a very full account of the life and researches of the late Charles Adolphe Wurtz, compiled by M. Friedel.

Journal für Praktische Chemie.
New Series, Vol. xxxi., No. 1, 1885.

Product of the Action of Phosphorus Pentachloride upon Succinyl Compounds and upon Tartaric Acid.—C. Kauder.—A very bulky memoir, not susceptible of useful abridgment.

The Action of the Halogens upon the Trimethylsulphine Salts.—L. Dobbin and O. Masson.—The author's experiments show that the halogen salts of trimethyl-sulphine can combine directly with the halogens and with iodine chloride. The halogen seems in no case to be expelled by another. The composition of the products of the reaction may be expressed by the formula

$(CH_3)_3SX_3$, where X signifies an atom of chlorine, bromine, or iodine. Those compounds appear the most permanent which contain one atom of iodine. If there is more than one atom of iodine present in the molecule, the substance cannot be obtained in a state of purity in consequence of peculiarities which appear connected with the accumulation of atoms of iodine, and which are often remarked in organic periodides.

A Homologue of Quinoline.—C. Beyer.—A preliminary notice of a base of the composition $C_{11}H_{11}N$.

Cosmos les Mondes.

New Series, No. 5, March 2, 1885.

This issue contains no chemical matter.

No. 6, March 9, 1885.

The only passage here at all connected with chemistry is a reassertion of the error that Philippe Lebon was the inventor of gas-lighting.

No. 7, March 16, 1885.

The only chemical matter in this issue is the notice of a case of poisoning due to a box of sardines. The tin lining of the box was sophisticated with lead, with the result that when the contents were exposed to the air lead oleate and carbonate were formed.

Moniteur Scientifique, Quesneville.

Vol. xv., March, 1885.

Completion of the Biography of Jean B. Dumas.—A. W. Hofmann.—From the *Berichte der Deutsch. Chem. Gesellschaft.*

Gold-purple.—Max Müller.—From the *Journal der Prakt. Chemie* and already noticed.

Lectures on Fermentation and Distillation.—Prof. W. N. Hartley.—From the *Journal of the Society of Arts.*

German Patents for Colouring-matters.—Patents taken out during November, December, and January last.

Patents relating to the Chemical Arts taken in France during 1884.—Titles of patents, giving no particulars. .

Review of Foreign Chemical Researches.—G. de Bechi.—Memoirs abridged from the *Ber. der Deut. Chem. Gesselsch.*

Homoquinine and its Partial Synthesis.—O. Hesse.

On Dicinchonine.—O. Hesse.—These two memoirs are taken from *Liebig's Annalen.*

MISCELLANEOUS.

The Chemical Society.—Fellows are reminded that the Anniversary Meeting of the Chemical Society for the Election of Office-bearers and Council will be held on Monday next, March 30th, at 8 p.m. By a clerical error on the balloting slips sent out the date was printed March 31st instead of March 30th.

Modifications of Ferric Hydroxide.—H. Hager.—The author obtained formerly three normal ferric hydroxides: a brown, amorphous compound, the terhydrate; a brownish-red or metamorphic bihydrate, and a red or crystalloid monohydrate. Recently he has obtained a a yellow modification of the terhydrate. It is not identical with the yellow hydrate of Tommasi, which is sparingly soluble in acids, but behaves chemically quite like the normal $Fe_2(OH)_6$, from which it is only distinct physically. The yellow compound is obtained by adding at once to dilute ferric chloride the necessary quantity of sodium carbonate solution. The precipitate is yellow with a cinnamon shade.—*Chemiker Zeitung.*

MEETINGS FOR THE WEEK

Saturday, 28th.—Physical Society, 3. "On Calculating Machines," illustrated by a collection of ancient and modern machines, lent by their owners for the occasion, by Mr. Jos. Edmundson. Exhibition of Instruments by Prof. Kennedy, Colonel E. D. Malcolm, Conrad C. Cooke, and A. Hilger.
Monday, 30th.—Medical, 8.30.
— Chemical, 8. (Anniversary Meeting). Election of Office Bearers and Council.
Tuesday, 31st.—Institution of Civil Engineers, 8.
Wednesday, April 1st.—Pharmaceutical, 8.
Thursday, 2nd.—Chemical, 8. Ordinary Meeting.

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"All engaged in the branch of industry for which this book is intended will certainly appreciate the manner in which the task has been performed."—*Mining Journal*, October, 1884.

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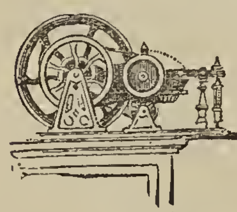

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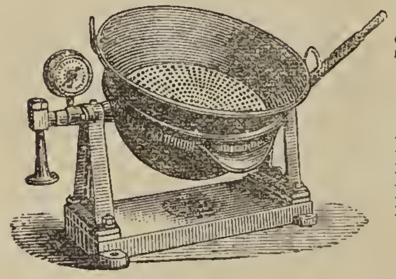

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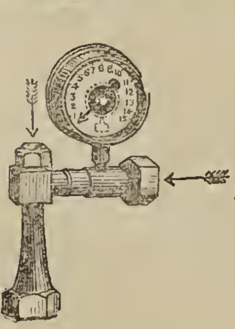

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THE CHEMICAL NEWS.

Vol. LI. No. 1324.

CONTRIBUTIONS TOWARDS THE SOLUTION OF THE CHEMICAL CONSTITUTION OF ISATIN.[*]

By H. KOLBE.

[The following pages contain the last experimental researches — unfortunately unfinished — of Hermann Kolbe, upon isato acid (Isatosäure) and its transformations. I have endeavoured, in drawing up this paper, to infuse into it the true meaning and spirit of the deceased. This difficult task has been made all the lighter for me from my having had, at the time of these investigations were being carried out, frequent conversations with him upon the subject of them, but especially by his own exact notes. Dr. Th. Bellmann and Herr G. Schmidt, who assisted Professor Kolbe in part of the researches herein described, have also given me valuable assistance.

The title of this paper, "Contributions towards the Solution of the Chemical Constitution of Isatin," is from the author himself. He began to write the paper but a few hours before his death. The opening paragraphs (printed in italics) are the last bequest which he has made to us. The concluding ones (also in italics) are taken from remarks made by him which were plainly meant to form a part of this communication.

E. v. Meyer.]

Notwithstanding that so many facts have been collected with the object of definitely settling the constitution of isatin, yet arguments of weight sufficient to support a hypothesis of its rational constitution, or indeed to raise it above the mere level of a hypothesis, are still wanting.

The property of isatin of forming crystalline compounds with the alkaline bisulphites led to the supposition of its belonging to the class of aldehydes or ketones; its property, when in contact with bases, of assimilating the elements of water, and therewith forming isatinic (Isatinsäure), from which stronger acids regenerate isatin, placed it in analogy with oxindol or cumarin, &c., which show a similar behaviour.

These facts alone, as already remarked, were not sufficient upon which to build a solid hypothesis of the constitution of isatin. That this has nevertheless been attempted simply proves how much the necessity was felt of finding for isatin its proper place among those compounds to which it is most nearly related.

Oxidation of Isatin by Chromic Acid. Isato Acids.

The first experiments upon the oxidation of isatin, which led to the discovery of the so-called isato acid (isatosäure), and also the behaviour of the latter, have been already shortly detailed.[†] Some of the statements then made as to the supposed composition of the compounds derived from that acid, require correction. Since then isato acid and its derivatives have been the subject of careful investigation.

If the supposition formerly expressed, viz., that isatin is a compound of formyl and nitrogen-benzoyl (stickstoff-benzoyl) be correct, then one might expect that it would, by suitable oxidation, be converted into a carbo-acid (carbonsäure), according to the following equation:—

$$(CO,C_6H_4N)COH+O = (CO,C_6H_4N)COOH.$$

Stickstoffbenzoylformyl. Stickstoffbenzoylcarbonsäure.

An acid of this atomic composition is in fact formed from isatin; this is the compound termed in the preceding communication Isato acid, which name shall be retained for it throughout this more complete paper.

The isatin used for its preparation was made in part by myself, by oxidising (natural) indigo by nitric or chromic acid, and partly commissioned from Schuchardt (in Görlitz) and from Kahlbaum (Berlin).[*]

A solution of chromic acid in acetic acid has shown itself to be the only suitable oxidising agent for the conversion of isatin into isato acid. The following mode of procedure, the result of many trials, has been found to be the best. About 600 grms. of glacial acetic acid (the half of the total quantity to be used), are poured over 100 grms. of finely powdered isatin placed in a large flask. The chromic acid (200 grms.) is brought, in moderate portions at a time (each time about one-sixth of the total quantity), into a funnel loosely stoppered by means of a glass rod, and a part of the remaining 600 grms. of acetic acid poured over it; by lifting up the glass rod, the solution is allowed to flow slowly into the mixture of isatin and acetic acid, which thereby becomes heated. As soon as the slightest ebullition (Aufwallen) is noticeable, the flask must be cooled by ice-water. After the mixture has become quite cold, the process is repeated as above, under frequent shaking, care being taken that the temperature does not rise above 50°, as otherwise the product undergoes partial decomposition.

After each addition of chromic acid, the colour of the liquid, at first red, becomes darker; when about the half of the chromic acid has been added, there begins to separate out a brown flaky substance, whose quantity goes on increasing, and before the whole has been run in the bottom of the flask is seen to be coated with a dirty grey layer. After the addition of all the chromic acid (besides the acetic acid), the flask, with its dark-brown coloured contents, is allowed, after frequent shaking, to stand in cold water for 12 hours. Should this be neglected, the liquid becomes heated again of itself (the reaction not being yet at an end), and this must be avoided in order to escape the accompanying partial decomposition.

At this stage the product contains as yet no isato acid. To complete the oxidation, the flask with its muddy contents is now allowed to stand for some hours in water, kept at 40° to 50°; a higher temperature is hurtful. These contents thus undergo a distinct change; the brown flakes vanish, a crystalline substance taking their place, and the liquid finally acquires the deep green colour of acetate of oxide of chromium. The product is lastly heated for several hours at about 60°; during this stage isato acid separates out in the form of a yellow crystalline powder.

To make this separation as far as possible complete, the whole is poured into 500 c.c. of extremely dilute sulphuric acid; the precipitate thus got, after being washed with cold water with the aid of a filter-pump, and spread out on paper to dry, is almost quite pure isato acid. The yield from 100 grms. isatin is 80 grms., *i.e.*, 72 per cent of the calculated amount. It is finally obtained absolutely pure by one crystallisation from boiling acetone. Other solvents are unsuitable for the purification of isato acid; water, which, even when warm, dissolves it with difficulty, causes decomposition, with evolution of carbonic acid. Ethyl and methyl alcohols etherify at the boiling temperature a part of the isato acid, this being easily recognised from the agreeable odour which the crystals retain. Even the minute quantities of methyl alcohol which acetone contains show their presence in this way.

Isato acid crystallises from hot acetone (of which about 23 parts at the boiling temperature are required for the solution of 1 part of acid) in hard yellow prisms, which appear to be almost rectangular; it melts at 230°, under

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[*] A Paper read before the Royal Society, March 12, 1885.

[†] *Journ. Prakt. Chem.*, [2], 30, 84, and 124.

[*] The fact, perhaps already observed by other chemists, that the isatin got with chromic acid is darker than that got with nitric, is explained by the tenacious adhesion to the first of small quantities of chromic oxide; by dissolving this preparation in hot caustic soda solution and precipitating the filtrate by dilute sulphuric acid, absolutely pure isatin is obtained from it.

decomposition, carbonic acid being given off, while at the same time a small amount of a substance crystallising in needles sublimes. The yellow colour is characteristic of isato acid. It is difficultly soluble in alcohol and glacial acetic acid, pretty difficultly in chloroform and benzol, and very slightly in ether.

The acid (crystallised from acetone) dried over sulphuric acid *in vacuo*, and then at 50°, yielded the following figures on analysis:—

I. 0·4516 grm. gave 0·9695 grm. CO_2 and 0·1307 grm. H_2O = 58·5 per cent C and 3·2 per cent H.

II. 0·3349 grm. gave 0·723 grm. CO_2 and 0·1307 grm. H_2O = 58·9 per cent C and 3·3 per cent H.

0·3336 grm. yielded 26·0 c.c. N (= 0·03003 grm. N) at 16°, and 753 m.m. pressure = 8·4 per cent N.

III. 0·284 grm. gave 0·612 grm. CO_2 and 0·085 grm. H_2O = 58·75 per cent C and 3·35 per cent H.

The composition thus got agrees with that of a nitrogen benzoylic acid, $(C_6H_4N,CO)COOH$.

	Calculated.		Found.		
			I.	II.	III.
C_8	96	58·9	58·5	58·9	58·76
H_5	5	3·0	3·2	3·3	3·3
N	14	8·6	—	8·4	—
O_3	48	29·5			
	163	100·0			

Adopting my idea of the composition of isatin, the process of its oxidation by chromic acid under observation of the above conditions proceeds, therefore, in this way, that the formyl of the isatin is changed to carboxyl, whereby nitrogen benzoylic acid (Stickstoffbenzoylcarbonsäure) is formed. (See Equation, *ante*.)

The chemical behaviour of isato acid, so far as I have studied it, is in fullest harmony with the supposition that it is nitrogen benzoylic acid. Of special importance for the right interpretation of its chemical constitution are its close relations to anthranilic acid, *i.e.*, O-amidobenzoic acid. It is readily and completely changed into the latter (or its derivatives) by various reagents, carbonic acid being separated and the elements of one molecule of water assimilated. This transformation of isato acid into anthranilic acid is shown by the following equation:—

$$(C_6H_4N,CO)COOH + H_2O = (C_6H_4NH_2)COOH + CO_2.$$

The two atoms of hydrogen of the water combine with the atom of nitrogen, which thereby becomes trivalent to amide; the oxygen atom of the water serves for the oxidation of the carbonyl, carbonic acid separating; from nitrogen benzoylic acid there thus springs amidophenylic acid (Amidophenylcarbonsäure).

Action of Water on Isato Acid.

As already mentioned, isato acid undergoes decomposition by prolonged boiling with water, carbonic acid being evolved. The dark-coloured powder which separated out on cooling yielded, after crystallisation from alcohol of 50 per cent, beautiful needles of anthranilic acid (melting-point 145°), from which, by solution in hydrochloric acid, the characteristic compound of the latter with anthranilic acid, of 191° melting-point, was obtained.

Behaviour of Isato Acid towards Mineral Acids.

If isato acid be gently warmed with ordinary strong hydrochloric acid, decomposition with foaming (evolution of carbonic acid) ensues; the crystalline mass obtained on evaporation is again dissolved in hydrochloric acid, in order to destroy all the isato acid. The residue, being dissolved in water, yields, on cooling, colourless prisms of hydrochloric (acid) anthranilic acid, containing one molecule of water.

0·392 grm. of the compound dried in an exsiccator over sulphuric acid, gave 0·630 grm. CO_2 and 0·188 grm. H_2O = 43·9 per cent C and 5·3 per cent H.

1·152 grm. of the same compound, precipitated by nitrate of silver, &c., gave 0·863 grm. AgCl, corresponding to 18·5 per cent Cl.

	Calculated for $C_6H_4NH_2,COOH.HCl+H_2O$.		Found.
C_7	84	43·9	43·9
H_{10}	10	5·2	5·3
N	14	—	—
O_3	48	—	—
Cl	35·5	18·5	18·5

From this hydrochloric acid compound anthranilic acid itself was precipitated in the usual way by the addition of ammonia and then of glacial acetic acid. From the hot aqueous solution, to which animal charcoal had been added, it crystallised in colourless prisms an inch long, which, according to the analysis, had the proper composition, and were also recognised as O-amido-benzoic acid through transformation, by means of nitrous acid, into salicylic acid.

0·3475 grm. gave 0·159 grm. H_2O and 0·780 grm. CO_2 = 5·1 per cent H and 61·2 per cent C.

Calculated for $C_6H_4NH_2,COOH$, 5·1 per cent H and 61·3 per cent C.

The transformation of the isato acid into hydrochloric acid anthranilic acid is complete as given in the above euqation, to which the hydrochloric acid, as taking part in the reaction, must be added.

Tolerably concentrated sulphuric acid acts upon isato acid in exactly the same way as hydrochloric does; the product is sulphuric acid anthranilic acid (Schwefelsäure-anthranilsäure), which can in this way be easily got, beautifully crystallised, in large quantities. The anthranilic acid separated from it gave an analysis corresponding to its composition.

Dilute nitric acid acts upon isato acid in a manner analogous to the above two acids, while concentrated forms it into a nitro-derivative which is described below.

Hydrochloric acid gas, acting upon the alcoholic solution of isato acid, decomposes it in such a manner that carbonic acid escapes, while the ethyl ether of anthranilic acid is formed. Hydrochloric acid gas was led to saturation, under gradual warming, into alcohol holding finely-powdered isato acid in suspension; the resulting clear solution congealed, on cooling, to a mass of pale yellow needles, which, after washing in the alcohol, or, better, ether, were analysed. The compound is hydrochloric acid anthranilic ether, $C_6H_4NH_2,COOC_2H_5.HCl$.

0·2330 grm. substance gave 0·4602 grm. CO_2 (0·1255 grm. C), and 0·1298 grm. H_2O (0·0144 grm. H).

Calculated for the formula $C_9H_{12}NO_2Cl$.	Found.
53·60 p.c. C.	53·86 p.c. C.
5·95 ,, H.	6·18 ,, H.

This compound is only slightly soluble in cold alcohol and not at all in ether. It melts at about 170°, and can he sublimed by cautious heating, but not altogether without decomposition. When brought in contact with water, hydrochloric acid anthranilic ether is decomposed into its constituents; the oil which here separated out, and which, after washing with water and drying over chloride of calcium, was distilled, is the ethyl ether of anthranilic acid, a strongly refracting liquid boiling at about 260°.

Analysis—

0·3233 grm. substance gave 0·7737 grm. CO_2 (0·2110 grm. C), and 0·1995 grm. H_2O (0·0221 grm. H).

0·3999 grm. substance gave at 15° and 754 m.m. pressure 30·2 c.c. N (0·3509 grm. N).

Formula.		Calculated.	Found.
C_9 ..	108	65·45 p.c. C.	65·26 p.c. C.
H_{11} ..	11	6·67 ,, H.	6·85 ,, H.
N	14	8·49 ,, N.	8·77 ,, N.
O_2 ..	32	19·39 ,, O.	
	165	100·00	

Action of Bases upon Isato Acid.

Basic substances decompose isato acid likewise with evolution of carbonic acid; since this takes place even at a low temperature, it has not been found possible to prepare salts of isato acid, as these undergo immediate decomposition into salts of carbonic and of anthranilic acids.*

Isato acid, when heated with baryta-water, yielded besides carbonate of baryta the anthranilic acid salt, which was extracted by saturating the solution with acetic acid and then shaking up with ether; its melting-point, as well as that of its hydrochloric acid compound, conclusively proved its having been formed.

The action of ammonia on isato acid is to this extent different, that not the ammonium salt of anthranilic acid, but its amide, which, so far as my knowledge goes, is not yet known, is formed.

Isato acid is readily taken up by aqueous ammonia; the solution immediately contains carbonate of ammonia, and after some time solidifies to a mass of yellow crystals, which, after being re-dissolved in hot water, separate out from the latter in glancing mother-of-pearl plates; the mother-liquor yields, on evaporation, a further quantity. This compound, which is extremely soluble in warm water and in alcohol, melts at 108°, and distils, with slight decomposition, towards 300°. Chloroform is a capital solvent for it, and from this it crystallises in large white plates; it is difficultly soluble in ether and hardly at all in benzoyl.

Analysis of Anthranilic Amide.

I. 0·346 grm. substance, dried over sulphuric acid, gave 0·776 grm. CO_2 and 0·195 grm. H_2O.

II. 0·155 grm. gave 0·350 grm. CO_2 and 0·084 grm. H_2O.

III. 0·234 grm. gave 41 c.c. N at 17° and 759 m.m. pressure.

IV. 0·353 grm. gave 0·793 grm. CO_2 and 0·200 grm. H_2O.

From this follows :—

Calculated for				Found.			
				I.	II.	III.	IV.
C_7	..	84	61·76 p.c.	61·15	61·58	—	61·27
H_8	..	8	5·88 ,,	6·27	6·02	—	6·29
N_2	..	28	20·58 ,,	—	—	20·31	
O	..	16					
		136					

A solution of caustic soda converts anthranilic amide slowly, and hydrochloric acid very quickly, into anthranilic acid (or its salts).

The same conversion of isato acid into this amide is brought about by the action of ammonia gas on the dry (isato) acid; at about 60° a vigorous action, with strong foaming, begins, and in a short time the whole is converted into anthranilic amide. The formation of the latter in this, as well as in the preceding case, is seen by the following equation :—

$$(C_6H_4N,CO)COONH_4 = C_6H_4NH_2,CONH_2+CO_2.$$

Ammon-isatoate (hypothetical). Anthranilic amide.

Aniline acts upon isato acid in an analogous manner to ammonia. A mixture of equivalent molecules of both was warmed to 60°, at which temperature the action, under strong foaming,† began and completed itself. The resulting clear solution solidified on standing for a short time to a mass of glancing plates; these crystals, after being pressed and washed with a little dilute hydrochloric acid, to free them from any adhering aniline, separated out from solution in benzol, in which they are difficultly soluble, in white colourless needles melting at 130°.

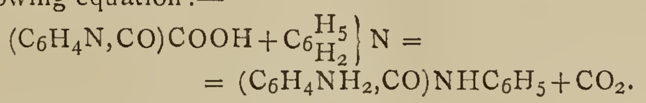
Analysis of this Compound.

I. 0·200 grm. of the substance, which had been dried for a long time at 80°, gave 0·105 grm. H_2O and 0·541 grm. CO_2.

II. 0·140 grm. substance gave at 16° and 739 m.m. bar. 16·3 c.c. N.

Calculated for $C_6{\begin{matrix}H_4\\NH_2\end{matrix}}\Big\}COHNC_6H_5$.				Found.	
				I.	II.
C_{13}	..	156	73·58 p.c.	73·75	—
H_{12}	..	12	5·65 ,,	5·83	—
N_2	..	28	13·20 ,,	—	13·19
O ..	..	16			
		212			

According to these figures the compound is *anthranilic anhydride*, $C_6H_4NH_2,CONHC_6H_5$, its formation corresponding to that of the amide, and being shown by the following equation :—



$$(C_6H_4N,CO)COOH+C_6{\begin{matrix}H_5\\H_2\end{matrix}}\Big\}N = \\ = (C_6H_4NH_2,CO)NHC_6H_5+CO_2.$$

Anthranilic anhydride dissolves pretty readily in water, and very readily in alcohol, ether, chloroform, and acetone; from the alcoholic solution it separates out in colourless columnar crystals (Säulen). Hydrochloric acid decomposes it gradually into anthranilic acid and aniline.

(To be continued.)

ANALYSIS OF BLACK SOIL OF MANITOBA.

By J. M. H. MUNRO, D.Sc., F.C.S.

THE subjoined analysis gives the composition of a sample of black prairie soil, taken from a farm near Birtle, Manitoba, by Prof. J. P. Sheldon, during one of his recent visits to that district. The sample was taken from the first 12 inches of depth, and when dried at 100° C. consisted of—

Organic matter and combined water	9·70
Small stones and gravel	1·41
Gravelly sand	2·45
Coarse sand	64·20
Fine sand	11·70
Clay, so-called, ignited	10·54
	100·00

Associated in air-dried soil with—

Moisture	6·70
Large stones	none
	106·70

The fine earth (passing through a sieve 30 meshes to the inch), when dried at 100°, contained—

Organic matter and combined water	10·07
Silica and insoluble silicates	83·41
Ferric oxide and alumina..	4·195
Carbonate of lime	0·96
Magnesia (MgO)	0·487
Potash (K_2O)	0·271
Phosphoric acid (P_2O_5)	0·195
Chlorine	0·010
Sulphuric acid	trace
	99·598
Total nitrogen	0·412
Total minerals soluble in water ..	0·048
Potash (K_2O) soluble in water ..	0·0081

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* That, on heating isato acid with soda-lime, aniline is set free, is explained by the previous formation of anthranilic acid, whose decomposition product it is.

† A small quantity of ammonia came off along with the carbonic acid.

The sample examined may be described as a fine sandy soil, remarkably free from stones, and owing its dark colour to vegetable matter, of which it contains a large quantity. The sand and gravel consist chiefly of fragments of quartz, with an admixture of spangles of mica, and other minerals derived from the older rocks. The proportion of nitrogen is very high, even when compared with the best English pasture soils. Potash and phosphoric acid are also in abundant supply, and the only element of fertility threatening to become deficient is *lime*. The high relative proportion of magnesia is noteworthy in connection with the grain-growing capacity of this soil.

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CHEMICO-PHYSIOLOGICAL INVESTIGATIONS ON THE CEPHALOPOD LIVER AND ITS IDENTITY AS A TRUE PANCREAS.[*]

By Dr. A. B. GRIFFITHS, F.C.S. (London and Paris),
Lecturer on Chemistry and Physics Technical College, Manchester.

In a memoir published in the Chemical News, vol. xlviii., p. 37, I gave some account of a peculiar excretory product found in the sepia's "liver." The product was found to be albumin in pseudo-crystalline aggregations when examined under the microscope. These bodies are not of a constant occurrence in this organ of the sepia. Since the publication of the above paper, which is a year and a half ago, I have made a thorough examination of this organ of the sepia, with the following results:—

After carefully dissecting it out of the cavity of the body of a fresh sepia I performed the following experiments:—

I. A small portion of the organ was placed on starch-paste. The starch granules disappeared with the exception of their celluloid covering, and on treating with water and testing the solution with Fehling's solution, sugar in the dextrose form was found.

II. The organ gave an alkaline reaction to litmus-paper.

III. When a small portion of the organ was placed in a tube with a little oil and agitated, an emulsion was produced; this emulsion had at first an alkaline reaction, and after some time became acid owing to the formation of butyric acid and other acids of the fatty series.

IV. The action of it on milk was to render the milk transparent in four hours' time. 15 c.c. of milk were rendered transparent by 6 m.grms. of the tissue of the organ.

V. When a few drops of the secretion of this organ were examined with chemical reagents under the microscope the following reactions were observed:—

On running in between the slide and cover-slip a solution of iodine in potassium iodide, a brown deposit was the result; and on running in concentrated nitric acid on another slide containing a drop or two of the secretion a yellow colouration was formed, due to the formation of xanthroproteic acid. These reactions show the presence of albumin in the secreted fluid of the organ.

Isolation of the Ferment of the Organ.

The process I followed to obtain the ferment or ferments in a crude state from the fluid of the organ was that devised by Wittich and used by Kistiakowsky (*Pflüger's Archiv fur Physiologie*, vol. ix., pp. 438-459) in his researches on pancreatic ferments. The process consists in hardening the organ in alcohol for three days, and then cutting it up into very small pieces, extracting with *glycerin*, and filtering. Then on the addition of alcohol to the filtrate, the ferment is precipitated.

The action of this ferment on starch was its complete conversion into dextrose or right-handed glucose, which was proved by Fehling's solution; and the formation of crystals ($C_6H_{12}O_6NaClH_2O$) with a solution of sodium chloride, a distinction between levulose or left-handed glucose, which does not form these crystals with salt solution.

The action of the ferment on fibrin from the muscular fibres of a young mouse was the formation of *leucin* and *tyrosin*, for on treating the fermented mass with hot water and filtering, a solution is obtained which contains leucin and tyrosin. To this solution was added acetic acid, when acicular crystals are deposited, insoluble in ether, but soluble in boiling water, and give, with a neutral solution of mercuric nitrate, a red flocculent precipitate, which is characteristic of tyrosin ($C_9H_{11}NO_3$).

The acetic acid solution, after precipitating the tyrosin (oxyphenyl-amido-propionic acid), is evaporated, when leucin ($C_6H_{13}NO_2$) is deposited in white shining plates which melt at 98° C.

These shining plates of leucin (amido-caproic acid) when heated with barium oxide yield amylamine and carbonic dioxide—$C_6H_{13}NO_2 = N(C_5H_{11})'H_2 + CO_2$. I obtained, by digesting the organ itself with boiling water, a filtrate containing leucin and tyrosin.[*] The ferment has no action on cellulose.

From these investigations I am led to the conclusion that the so-called "liver" of *Sepia officinalis* (the cuttle-fish) is *not* a true liver, but is a *pancreas*; for the juices of the organ in question are purely digestive in function—digesting starch, oil, and similar bodies, and transforming fibrin into leucin and tyrosin. Then, again, albumin is found in its secretion, which is characteristic of the pancreatic fluid of the higher animals. No albumin being found in the liver, for albumenoids are decomposed by that organ. This organ of the sepia digests oil globules, and the secretions from a true liver are incapable of digesting fats without the pancreatic fluid.

No glycocholic and taurochloric acids nor glycogen were obtained from the organ, nor could the slightest trace of them be detected in the organ or its secretion.

The above investigations prove that this so-called "liver" of the cephalopod is a true pancreas or digestive organ.

Concerning the literature of this subject the following memoirs may be consulted with advantage:—

I. Jousset de Bellesme.—*Comptes Rendus*, lxxxviii., 304, also p. 428 [1879].
II. Krukenberg.—*Untersuch. Physiol. Inst. Heidelberg*, Bd. i., p. 327 [1878]; also Bd. ii. [1879].
III. Fredenig.—*Bull. Acad. Sciences Belgique*, xlvi., p. 761 [1878].
IV. *Rev. Scien. Internal*, iii., pp. 263, 271 [1879].

PHENOL-PHTHALEIN AS AN INDICATOR.

By J. H. LONG.

In the past few years, owing to the increasing demands of the arts, volumetric processes of chemical analysis have grown in importance and general favour. The gradual introduction of such methods into the pharmacopœias of several countries has been a step in advance, and it is now true that there is scarcely a substance in common use which cannot be estimated with more or less accuracy by one of these processes.

A requisite of a good volumetric method is that there must be a sharp end reaction, and this is brought about in various ways. In some cases the termination of the

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[*] A Paper read before the Royal Society, Edinburgh, March 16, 1885. Communicated by Dr. W. E. Hoyle, M.A., F.R.S.E., of the Challenger Expedition Office, Edinburgh.

[*] These crystals of leucin and tyrosin from the cephalopod "liver" are preserved as microscopic slides.—A. B. G.

process is indicated by the subsidence of a precipitate, as in the Gay-Lussac silver titration; in others, from time to time a drop of the liquid in the beaker to which the reagent is being added is brought in contact with a drop of some solution on a dark plate, when the appearance of a colour indicates the end, as in Liebig's urea process. In other cases, a few drops of the indicator are added to the liquid to be tested, and after addition of sufficient of the reagent, a change of colour shows the termination of the process. We have illustrations of this in the Mohr silver titration, and in most of the processes of alkalimetry and acidimetry. The determination of free acids and alkalies being of very great importance, more attention has, perhaps, been given to indicators for this purpose than for any other, and, thanks to the numerous discoveries of organic chemistry, scarcely a month passes in which a new indicator is not suggested. Many of these prove of little or no value; others, as rosolic acid, phenol-phthalein, methyl-orange, phenacetolin, and flavescin, have a value, and will probably remain in use. One of these, phenol-phthalein, has attracted no little attention recently, and in the following I propose to consider the chief advantages and disadvantages in its use:—

In a paper on the phenol colouring matters, read before the German Chemical Society (Berlin), in 1871, Prof. A. Baeyer described a new compound obtained by the action of phthalic anhydride on phenol in presence of concentrated H_2SO_4:—

$$C_8H_4O_3+2C_6H_6O=C_{20}H_{14}O_4+H_2O.$$

To the purified product he gave the name phenol-phthalein, and found that its solution in alcohol yielded an intense red colour with soda or potassa. Luck (*Fres. Zeitschr.*, 1877, p. 332) in experimenting with it, found it very sensitive with alkaline solutions, and recommended it as an indicator. Soon after this, Borntraeger (*Fres. Zeitschr.*, 1878, p. 459) carried out comparative tests of a number of indicators, litmus, coralline, phenol-phthalein, and orange-peel tincture (the last being a new one prepared by himself), from which it would appear that phenol-phthalein follows some of the others in point of delicacy of reaction. But a scrutiny of his figures will show that his conclusions are scarcely justifiable. In the first place, 10 c.c. of a normal acid or alkali solution is too small an amount to use in exact work, and this is the volume he used in several instances. In another case, 1 grm. of $CaCO_3$ was dissolved in HCl, and the excess of acid determined by NaOH. When phenol-phthalein was used as the indicator, it appeared that 19·7 to 19·8 c.c. of acid was required instead of 20 c.c. The discrepancy here is doubtless due to the fact that before titration the excess of CO_2 had not been thoroughly expelled. The results obtained in presence of ammonium salts appear likewise to contradict each other.

About the same time, J. T. Dunn (J. B., 1878, p. 1055) published the results of tests carried out by him, from which he concluded that phenol-phthalein was less sensitive than litmus. Thus far, it seems, the peculiar behaviour of phenol-phthalein with CO_2 had not been observed, and to this, without doubt, may be traced the unfavourable reports given of it. Warder (*Am. Chem. Journ.*, iii., p. 55) was the first to call attention to the fact that while very sensitive to caustic and monocarbonated alkalies, it is neutral to bicarbonates. Lux (*Fres. Zeitschr.*, 1880, p. 457) had shown how flavescin, a new substance isolated by him, could be employed to distinguish between free and carbonated alkalies, and in this paper Warder shows how phenol-phthalein can be used for the same purpose. To illustrate this, suppose we have a dilute solution of Na_2CO_3, and that to this HCl be added. We can look upon the first reaction as the formation of bicarbonate:—

$$Na_2CO_3+HCl=NaCl+NaHCO_3.$$

With an indicator neutral to bicarbonates the colour would disappear on addition of half the amount of acid necessary for complete decomposition, and practically this reaction can be utilised in quite dilute solutions of NaOH, containing some Na_2CO_3, as the following equations will illustrate:—

$$NaOH+Na_2CO_3+2HCl=2NaCl+NaHCO_3+H_2O,$$

and such a solution would be neutral to our indicator. After boiling, which decomposes $NaHCO_3$, another molecule of HCl must be added to neutralise, from which it follows:—

$$\begin{array}{l} 2HCl+1HCl=\text{caustic and carbonated alkali.}\\ 2HCl-1HCl=\text{caustic alkali.}\\ \hline \quad 2HCl=\text{carbonated alkali.} \end{array}$$

From the above, it can readily be seen how the process is to be carried out.

Similarly, to distinguish between carbonates and bicarbonates:—

$$Na_2CO_3+2NaHCO_3+HCl=NaCl+3NaHCO_3.$$

If acid be added to a cold solution the colour is lost when the proportions are as above; that is, when the mono-carbonate is converted into bicarbonate. To lose all colour after boiling we have:—

$$2Na_2CO_3+4HCl=4NaCl+2H_2O+2CO_2.$$

In general, if x c.c. of acid be required, before boiling, to neutralise a mixture of mono and bicarbonate, and after boiling y c.c., then $2x$ c.c. is the acid equivalent to the Na_2CO_3 and $y-2x$ is that equivalent to the $NaHCO_3$.

It will be seen that these reactions pointed out by Lux and Warder are of great practical value, as they make it possible to test these commonly occurring mixtures very easily.

In the CHEMICAL NEWS (xlvii., pp. 123, 135, and 184) Robt. T. Thomson published a very full investigation comparing litmus, rosolic acid, methyl-orange, phenacetolin, and phenol-phthalein, when used in titrating pure acids, and also acids in presence of various salts. From his numerous experiments, he concludes that the last named is certainly as sharp and reliable as the others in titrating all the mineral acids or ordinary alkalies except ammonia, and in presence of nearly all salts excepting those of ammonium. For the organic acids, citric, tartaric, oxalic, and acetic, he finds it more delicate than the others, a point which I am able to corroborate, as numerous tests I have made show fully the greater sensitiveness of phenol-phthalein. I am also inclined to think that where great delicacy is desired in titrating the mineral acids, it is much superior to any of the others, and if one wishes to work by lamp light its advantages are very great. It renders good service, also, in titrating alcoholic solutions of the heavy fatty acids with KOH. The molecular weight of these acids being large, the alkaline solution must be very dilute to employ volume enough to read off accurately. As the indicator loses nothing in sensitiveness with these acids, it gives colour with the slightest excess of alkali. The practical application and advantage of this can be seen, for instance, in the titration of butter fat by the Koettstorfer method (*Fres. Zeitschr.*, 1879, pp. 199 and 431).

Gavalovski has recently recommended a mixture of phenol-phthalein and methyl-orange as an indicator of the neutral point in titration. While, as a rule, either an excess of acid or an excess of alkali is shown, this mixture gives a neutral tint. When alkali is in excess it is deep red. When acid is in excess it is rose-red, but at the exact neutral point it is bright lemon-yellow. — (*Fres. Zeitschr.*, 1883, p. 397.)

The fact has been referred to above that in presence of ammonium compounds, phenol-phthalein does not give sharp results. In order to test the disturbing influence of these salts, I have carried out a number of tests at different temperatures in the presence of varying amounts of NH_4Cl, and employed of this a solution containing 100 grms. of the pure salt to the litre. The phenol-phthalein contained one-half per cent of the substance in strong alcohol.

Experiment 1.—Took 25 c.c. N/2 HCl, added 10 c.c. NH_4Cl, and one drop of indicator. Ran in now 28 c.c. N/2 NaOH to distinct colouration. Temperature, about 20° C.

Experiment 2.—Took 25 c.c. N/2 HCl, 10 c.c. NH_4Cl, and one drop of indicator, and heated to boiling. Removed from the flame, and ran in 32 6 c.c. N 2 NaOH to first colouration, which was not sharp, and the addition of more NaOH did not deepen it much.

Experiment 3.—Took 25 c.c. N/2 HCl, 10 c.c. NH_4Cl, one drop of indicator, and ran in about 28 c.c. N/2 NaOH to first colouration. Heated now to boiling, which caused the colour to disappear, and then restored it by more alkali, making in all 37 c.c. used. On boiling again the colour disappeared, and repeating these operations several times a permanent colour was obtained after addition of 61·5 c.c. N/2 NaOH. Subtracting 25 c.c. used for the acid, we have 36 5 c.c. remaining, which equals the amount used because of the presence of the NH_4Cl. This is very nearly the amount necessary to expel the ammonia, 37·4 c.c. being required by theory, and the discrepancy is probably due to the fact that some little NH_4Cl would be lost by evaporation. It seemed, therefore, probable that no permanent colour could be obtained until after the destruction of this compound.

Experiment 4.—Took 10 c.c. NH_4Cl diluted with water, added 38 c.c. N/2 NaOH, a drop of indicator, and boiled to expel NH_3. Now ran in 25 c.c. N/2 HCl, and brought again to boiling; 24·3 c.c. N/2 NaOH were required to give colour. We have now $38+24·3-25=37·3$ c.c. N/2 NaOH used to expel NH_3. This is so close to the theoretical amount that it is safe to say that ammonia forms no permanent compound with the indicator, and that the latter undergoes no destructive change in the process. Similar tests were made using H_2SO_4, with like result.

Experiment 5.—From Experiments 1 and 2 it is seen that the action of the ammonium salt depends somewhat on the temperature. A number of titrations were made at different temperatures to show the variations in this disturbance.

In every case 25 c.c. N/2 HCl, 10 c.c. NH_4Cl, and 65 c.c. H_2O were taken, and, after the addition of 24·9 c.c. N/2 NaOH and the indicator, the mixture was cooled or heated to the required temperature, and the exact amount of NaOH added to colouration. The temperatures given are the means of those at the beginning and end of this final titration.

Temp.	C.c N/2 NaOH.
6·5	26·2
13·5	27·0
22·5	27·6
30·0	28·1
38·0	28·7
49·5	29·9
62·0	31·0
69·1	32·0
76·0	32·8

The colour was not sharp in any case, and the volumes read off are consequently only near approximations to the truth. I found, also, in a number of tests, that by increasing the amount of phenol-phthalein the colour appeared somewhat quicker. When 1 c.c. of a *five per cent* solution of the indicator was added to a mixture as above at 15° C., the first colour appeared on addition of 25·8 c.c. N/2 NaOH. But it is probable that the colour would have come as soon with a smaller amount, as this was more than could be held in solution. On running in 1 c.c. more of the alkali the colour became stronger, but on addition of more NH_4Cl it vanished. This suggested titration in presence of variable amounts of this substance, which was done, as follows:—

Experiment 6.—The volume of solution acted on was 100 c.c., consisting of 25 c.c. N/2 HCl, 10 c.c. NH_4Cl, and 65 c.c. H_2O in the first case, the same amount of acid, 20 c.c. NH_4Cl, and 55 c.c. H_2O in the next, and so on. The temperatures varied between 14° and 15° C. One drop of the indicator was used.

N/2 HCl.	NH_4Cl.	H_2O.	N/2NaOH.
25	10	65	27·1
25	20	55	27·9
25	30	45	29·0
25	40	35	30·5
25	50	25	31·5
25	60	15	32·6
25	70	5	33·8

As in the case above, where the titrations were made at different temperatures, the results were not sharp. At the appearance of the first colour the addition of alkali was stopped.

Experiment 7.—A few drops of the indicator were added to 10 c.c. of strong ammonia solution (26 per cent). The deep red colour was permanent several hours, but at the end of twenty-four hours it had faded very considerably. By partial neutralisation with dilute H_2SO_4 the deep colour was restored.

To a similar solution the indicator was added, and then 5 c.c. of a strong (ca. 20 per cent) solution of soda; the deep colour, which was present at first, disappeared in about one minute. On dilution with water it partially reappeared, and by acids, leaving a slight excess of alkali, it was completely restored.

The experiment was next tried of adding the indicator directly to strong NaOH. The red colour which appeared at first vanished soon, as observed by Baeyer (J. B., 1880, p. 674), but was restored by partial neutralisation with an acid, as when ammonia was present.

On mixing dilute solutions of soda and ammonia a gradual disappearance of colour was also observed, but the exact point at which all colour was destroyed could not be sharply defined. Acids, added to partial neutralisation, restored the colour here as in the cases of the stronger solutions.

From the above it will be seen that the behaviour of phenol-phthalein with ammonia is a very peculiar one. I am inclined to think, however, that an explanation of some of the facts observed may not be difficult.

Baeyer and Burkhardt (*Ber. der Deutseh. Chem. Gesell.*, 1878, p. 1297) have shown that phenol di-imido-phthalein is formed by the action of aqueous ammonia on phenol-phthalein at a temperature of 160° to 170° C. This is a colourless body, soluble in alkalies without colour, and decomposed by acids forming phenol-phthalein and ammonia again.

It seems to me probable that the same reaction may take place at ordinary temperatures if the ammonia is liberated from a compound in the presence of the phthalein.

The higher the temperature the more rapid would be the liberation of NH_3 from NH_4Cl by NaOH, and hence the larger volume of the latter required to give colour in Exp. 5. Increasing the amount of NH_4Cl would have the same effect, as shown in Exp. 6. According to Baeyer the substances unite in this way:—

$$C_{20}H_{14}O_4+2NH_3=C_{20}H_{16}N_2O_2+2H_2O\ ;$$

from which it is readily seen that it would not be difficult to soon liberate an excess of NH_3 sufficient to completely saturate the small amount of indicator used. I have mentioned the fact that the colour obtained on adding the soda to the solution containing an ammonium salt is only slight at best, and that it can be made to disappear by adding more of the latter. This seems to me a further support of the hypothesis, as also the fact that acid restores the colour lost by mixing dilute solutions of soda and ammonia in presence of the indicator.

In neutralising the excess of ammonia a salt of ammonium is formed, and the increase of colour under these circumstances shows plainly enough that it is not an ammonium compound, but the free ammonia itself, which acts on the phenol-phthalein to produce a colourless compound.

The results of other experiments now in progress, which I think will fully explain some of the points not yet clear, will be reserved for future publication.—*The Pharmacist.*

CONTRIBUTIONS TO THE CHEMISTRY OF MALTING.

Part I.

Extraction of Inorganic and Organic Matter by the Steeping Water.

By Professor BEHREND, of Hohenheim.

In an introduction to this paper it is pointed out that, although the scientific investigation of the chemistry involved in the process of brewing and the manufacture of alcohol is of comparatively recent date, some twenty years old, nevertheless the amount of work done in this direction is of an extremely extensive and exhaustive character. There still remains, however, an extensive field both for present and future research; take for example the scantiness of our knowledge concerning the chemical changes accompanying the fermentation of various saccharine fruits employed, more especially in South Germany, for the manufacture of alcohol. The author, as the title of the present communication indicates, has not gone so far afield to find a gap in our knowledge as regards brewing-chemistry. When steeping barley for the preparation of malt, it is very important that the water used should not extract much of the most valuable constituents (such as phosphoric acid and potash) of the grain, otherwise the yeast in subsequent operations may languish for nourishment. As is well known the amount of matter dissolved out depends on numerous circumstances, *inter alia* the quality of the water, the temperature, the duration of the steeping, &c. The first series of results, described in the present communication, illustrate the influence exerted in this direction by the size of the grains. Three kinds of barley have been employed in these experiments, obtained respectively from Saxony, Bohemia, and Hungary. In the experiments 10 litres of water were poured on 10 kilogrms. of each kind of barley contained in a suitable conical tin vessel provided with an outlet for water at the lower end; after 14 hours the first "steeping-water" was run off and measured. The deficiency from 10 litres representing the quantity retained by the grain, it seems that the smaller grains retain slightly more water than the larger kinds. A second 10 litres of water was then added and replaced, after 24 hours by a third 10 litres. The third "steeping water" likewise remained 24 hours in contact with the barley, which was then fully steeped.

Aliquot volumes of each of the three "steeping waters" were evaporated, dried at 110° to 115° C., weighed, burnt, and again weighed; the weights obtained in this manner giving the total solids and the inorganic and organic matter extracted. The water employed was exceptionally hard, and contained per litre 0·056 grm. organic and 0·354 grm. inorganic matter. The weights in grms. of 1000 dried grains of each of the kinds of barley were as follows:—Saxon, 40·22; Bohemian, 35·82; Hungarian, 33·44. The results obtained are tabulated below.

From these Tables it will be observed that the first steeping water extracts the largest quantity of solid matter from the barley, whilst the third extracts the least, but nevertheless a considerable quantity. It will, however, be remarked that the first two "waters" extract more inorganic than organic matter, whereas the state of things is reversed in the third water, in which the quantity of organic matter exceeds that of the inorganic. Special attention should be given to the fact that, when treated in a similar manner, the smaller grains yield more to the water than the larger ones do, no matter from what standpoint the matter is viewed. It is scarcely necessary to add that this latter fact is of great value to the brewer. All these conclusions are easily explained when we remember that the extraction is the result of osmotic action.

A NEW SEWAGE PROCESS.

At the suggestion of Dr. Thresh, a novel process has been devised for treating the sewage of Buxton. The precipitant brought into play is simply a mineral water derived from the lower coal-formations about two miles above Buxton. It contains 1·2 grs. of iron per gallon in the state of ferrous carbonate, held in solution by carbonic acid. On exposure to the air the carbonic acid escapes, and the iron, taking up more oxygen, subsides in the state of ferric hydroxide in combination with a considerable part of the organic impurities, suspended and dissolved. The results, according to an analysis quoted in

Solid Matter dissolved by 1 Litre of Steeping Water.

By—	From Saxon Barley.			From Bohemian Barley.			From Hungarian Barley.		
	Organic.	Inorganic.	Total.	Organic.	Inorganic.	Total.	Organic.	Inorganic.	Total.
1st steeping water	1·814	2·011	3·825	2·056	2·284	4·340	2·829	3·101	5·930
2nd ,, ,, ...	0·485	0·705	1·290	0·634	0·942	1·576	1·038	0·870	1·908
3rd ,, ,, ...	0·511	0·199	0·710	0·488	0·279	0·767	0·541	0·275	0·816

Solid Matter dissolved by the "Steeping Waters" from 10 Kilos. of Barley.

By—	From Saxon Barley.			From Bohemian Barley.			From Hungarian Barley.		
	Organic.	Inorganic.	Total.	Organic.	Inorganic.	Total.	Organic.	Inorganic.	Total.
1st steeping water	12·90	14·28	27·18	14·39	15·99	30·38	20·15	22·08	42·23
2nd ,, ,, ...	5·25	6·32	11·57	5·68	8·44	14·12	9·13	7·66	16·79
3rd ,, ,, ...	4·76	1·86	6·62	4·55	2·60	7·15	4·98	2·53	7·51
Total	22·91	22·46	45·37	24·62	27·03	51·65	34·26	32·27	66·53
10 kilos. barley contain grms.	8037	223	8260	7991	239	8230	8221	239	8460
Per cent dissolved by the combined steeping waters	0·22	10·07	0·55	0·31	11·31	0·63	0·42	13·50	0·79
1000 barley grains contain..	38·17	1·05	39·22	33·88	1·01	34·89	32·53	0·94	33·47
M.grms. dissolved from 1000 barley grains	109	107	216	105	115	220	135	128	263

the *Leek Times*, are very satisfactory. The sewage before treatment contains free ammonia 11·74 per million, and albumenoid ammonia 1·60. After treatment these figures are reduced to free ammonia 4·00 parts per million, and albumenoid ammonia 0·30 do. The sewage is decidedly weak, but the purification effected is very satisfactory, coming far within the limit proposed by the late Rivers' Pollution Commissioners, and supplying additional proof that mineral salts are fully capable of precipitating dissolved organic impurities. Such waters are not uncommon, and may find similar applications elsewhere. The only unsatisfactory point which we note is that the effluent is stated as being "distinctly alkaline."

PROCEEDINGS OF SOCIETIES.

RUSSIAN PHYSICO-CHEMICAL SOCIETY.

Chemical Section.

February 7/19, 1885.

The President, Prof. D. Mendeleiff, in the Chair.

A. Krakan read a paper on "*The Deduction of the Number of Isomeric Derivatives of Benzene according to the Theory of Substitution*," and points out some inexactitudes of the method proposed by N. Menshutkin.

N. Menshutkin said that he proposed to consider these objections when the paper was published.

N. Kaiander presented some remarks on the paper of N. Menshutkin on "The Isomerism of Hydrocarbons."

Prof. A. Butlerow read a paper on "*Chemical Structure, and the Theory of Substitution.*"

Remarks were made on this paper by N. Menshutkin, who stated his intention to make in due time a more particular examination of it, and D. Mendeleiff, who mentioned the history of the question, pointed out the want of precision from a mechanical point of view in the distinction between the conceptions of "linking" of elementary atoms and their influence upon each other, and finally discussed the question of the atomicity of elements.

N. Kaiander remarked on papers published by Ostwald (Chemical News, vol. l., p. 164; *Journ. f. Prak. Chem.*, 1884) and Arrhenius (*Swed. Acad. of Sci.*, 1884), on the relation of electric conductivity to the faculty of entering reactions, that this relation was examined by him, and his results published in 1881 (abstracts in *Ber. d. Deut. Chem. Ges.*, xiv., 2058, 2676, and *Beibl. zu Wein. Ann.*, v., 829, and vi., 317).

Nos. I. and II. of the *Journal* for 1885 contain the following papers:—

I. N. Menshutkin, "On the Isomerism of Hydrocarbons according to the Theory of Substitution."

M. Shal'eieff, "On the Preparation of Hæmin, according to Teichmann's Method, without previously submitting the Blood to any particular treatment."

A. Lagorio, "On the Crystalline Form of Hæmin obtained by the former method."

M. Gadzietzky, "On an Automatic Apparatus for Washing Precipitates."

F. Barzylowsky, "On the Oxidation of Aromatic Amines."

E. Wroblevsky, "Contribution to the question of the Action of Alcohol upon Diazo-compounds."

V. Alexeieff, "On the Isomerism of Solutions."

D. Konovaloff, on the same subject.

Protocol of the December meeting of the Physico-Chemical Commission of the Society of Naturalists in Moscow, containing communications of Sabaneieff on diallyl and its bromine compounds; Pavlov, on tetric acid (the same as above); and Milkovsky, on heptanaphthene from Caucasian petroleum.

II. G. Gustavson, "Thermic Data for Compounds of Aluminium Bromide with Hydrocarbons." (comp. protoc.)

E. Shatzky, "On Diallyloxalic Acid, its Salts, and some of its Transformations."

The same author, "On the Preparation of Oxalic Ether."

F. Bevad, "On the Rate of Formation of the Carbonates of Alkaline Earths in Relation to Time, Masses, and Nature of the Body ($Li_2CO_3,Na_2CO_3,K_2CO_3$) used for Precipitation."

NOTICES OF BOOKS.

Poisoning by Canned Goods. By J. G. Johnson, M.D. New York; Vanden Houten and Co.

This pamphlet gives an account of six cases of corrosive poisoning, all in one family, from eating tomatoes put up in tins. None of the patients died, though three were for some time in imminent danger. On examination it appeared that the cap of the tin had been soldered on, not with a "resin amalgum" (*sic!* several times repeated), but with a compound of zinc chloride containing free acid, which had attacked the tin. The poison, therefore, was a mixture of zinc and tin chlorides. The author very justly argues that so poisonous a substance as zinc chloride should not be used in soldering up tins of food, and should not be allowed in the premises of persons carrying on the canning trade.

CORRESPONDENCE.

FERRICYANIDE OF MANGANESE.

To the Editor of the Chemical News.

Sir,—In the ninth edition of Dr. Remigius Fresenius's "Qualitative Chemical Analysis" (Vacher's translation, 14th edition, 1876), p. 114, § 107, "Reactions of Protoxide of Manganese," the following statement occurs:—"Ferricyanide of potassium precipitates brown ferricyanide of manganese (3Mn, Cfdy) insoluble in hydrochloric acid and ammonia."

I find that on adding hydrochloric acid and heating gently the ferricyanide of manganese entirely dissolves. Hence it appears to me that the above should have been written as follows:—Ferricyanide of potassium precipitates brown ferricyanide of manganese, soluble in hydrochloric acid, insoluble in ammonia.

I suppose that the error must have been due to a misprint; but it appears to me rather remarkable that, in a work of such undoubted merit as the above-named, any errata should not have been scheduled in the usual way.

I do not think that attention has ever before been called to this inaccuracy, and, as it may be useful to your readers to note the same, I trust that you will excuse this intrusion upon your valuable space.—I am, &c.,

L. M. Deane,
Assistant Analytical Chemist, Sir W. G. Armstrong, Mitchell, and Co., Newcastle-on-Tyne.

Bromo-substitution of Phenolic Hydrogen Bromised Tribromo-phenol.—E. Werner.—The author dissolves the equivalent of phenol in 60 litres of water, and pours rapidly into any volume of this solution an equal volume of bromine-water containing at least 20 grms. bromine per litre. The bromised tribromo-phenol is deposited in crystalline scales.—*Comptes Rendus*, Vol. c., No. 11.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

Note.—All degrees of temperature are Centigrade unless otherwise expressed.

Comptes Rendus Hebdomadaires des Séances, de l'Académie des Sciences. Vol. c., No. 9, March 2, 1885.

Origins of Alchemy.—M. Berthelot.—A very brief notice of a work which M. Berthelot has just published, founded, it is said, on the direct study of Greek MSS. and papyri existing in the libraries of Paris, London, Berlin, and Leyden.

Researches on Isomerism in the Aromatic Series: Neutralisation-heat of the Polyatomic Phenols.—MM. Berthelot and Werner.—A thermo-chemical study of resorcine, orcine, hydroquinone, pyrocatechine, quinone, phloroglucine, and pyrogallol. The authors emphasise the importance of thermo-chemical determinations for establishing the true function of the series of aromatic isomers.

A Characteristic Reaction of the Secondary Alcohols.—G. Chancel.—The formation of alkyl nitrous acids is so distinct that it furnishes an excellent reaction, requiring but little material, to show whether any given alcohol is primary or secondary. It is merely requisite to attack about 1 c.c. by nitric acid in a test-tube; to pour upon the product first water and then ether, and to agitate the whole. The ethereal stratum is decanted into a watch-glass. After the evaporation of the ether the residue is dissolved in a little alcohol, and a few drops of alcoholic potassa are added. With a primary alcohol nothing particular is produced; but if we have to do with a secondary alcohol an alkyl-nitrite soon appears in the form of small yellow prismatic crystals.

Action of Hydrogen Peroxide upon Cerium and Thorium Oxides.—Lecoq de Boisbaudran.—(See page 148.)

Correction of a Former Communication on the Spectrum of Samarium.—Lecoq de Boisbaudran.—At the origin of the author's researches on samarium, and when he had in his hands but scanty material, he observed on passing the induction-spark over the hydrochloric solution of the earth four bands of little intensity, having their more refrangible extreme margins situate about 578, 566, 489, and 461. The emission spectrum, unknown at the time of those observations, accompanied the fine absorption bands so characteristic of samarium, and seemed in consequence due to this new element. This opinion requires to be rectified, for the spectrum with four emission bands disappears from the samarium compounds when they have been fully purified. M. Marignac having furnished the author with a specimen of his earth Yt_{α}, he has been able to design its spectrum, and he finds there the above-mentioned bands with much greater intensity.

Reclamation of Priority as regards the Process for Annulling the Extra Current, used by M. d'Arsonval for avoiding the dangers of Mechanical Generators of Electricity.—A. Daussin.—The author patented the process in question as far back as March 25, 1869.

Means of Annihilating or Diminishing the Dangers of the Extra-current in Dynamo-machines in case of a Rupture of the Outer Circuit.—J. Rainaud.—The author proposes for this purpose a simple arrangement founded on Faraday's principle of lateral induction, used in telegraphy under the name of safety-rods, to secure the bobbins of the apparatus against atmospheric electricity. It is merely necessary to connect to the poles of the machine the terminals of an instrument of this kind, which then forms a safety-valve, giving passage to the current at the moment when it becomes dangerous.

The Limit-Density and the Atomic Volume of Gases, and in particular of Oxygen and Hydrogen.—E. H. Amagat.—The author has reduced oxygen to the 1-900th part of its volume. Its density was then much higher than that of water. With the greatest pressure producible the density obtained exceeded 1·25, and this at a temperature of 17°. Hence unity cannot be admitted as the limit of density. As regards hydrogen, the limit density deduced from the author's experiments is 0·12. On referring to Meyer's curve, it appears that the summit of the ordinate representing the atomic volume of hydrogen will fall on the regular production of the curve passing through the summits of lithium, sodium, and potassium. Hence, conformably to the ideas of Dumas on the metallic nature of hydrogen, we may recognise between this body and lithium a period analogous to those which follow, but in which no known body can be placed.

Composition of the Gaseous Products of the Combustion of Iron Pyrites, and Influence of Glover's Tower upon the Manufacture of Sulphuric Acid.—M. Scheurer-Kestner.—(See page 148.)

The Separation of Alumina and Ferric Oxide.—P. Vignon.—The author adds to the liquid containing the two substances in solution a large excess of concentrated trimethylamine, lets settle for twenty-four hours, washes with trimethylamine, brings the precipitate on a filter, and continues the washings until a drop no longer leaves an appreciable residue. The precipitate is dried, slightly calcined, and is weighed as ferric oxide after adding the ash of the filter. The alumina is found in the filtrate and washings. It appears that trimethylamine possesses the property of re-dissolving chromium sesquioxide in presence of ferric oxide. The author hopes to found upon this reaction a method for separating chrome from iron.

Certain Basic and Ammoniacal Nitratos.—G. André.—The author describes ammoniacal zinc nitrate, the action of zinc oxide upon ammonium nitrate, and the action of litharge upon the same salt.

The Composition of Ammonium-Glyoxal-Bisulphite.—M. de Forcrand.—The author gives for this compound the following formula $C_4H_2O_4,2(NH_4O,S_2O_4)2HO$.

Vol. c., No. 10, March 9, 1885.

Bromo-substitutions of the Polyatomic Phenols.—MM. Berthelot and Werner.—A thermo-chemical study of the formation of the tribromo-compounds of resorcine, orcine, phloro-glucine, pyro-gallol, pyro-catechine, and hydro-quinone.

The Decomposing Action of Aluminium Chloride upon certain Hydrocarbons.—C. Friedel and J. M. Crafts.—The authors, after having studied the synthetic reactions which may be effected in the aromatic series by means of aluminium chloride, are now studying the decompositions set up by the same agent when heated with the hydrocarbons. From triphenyl-methane they have obtained benzol without an appreciable proportion of toluol, and a hydrocarbon having the appearance of asphalt, which is destroyed on distillation. If the triphenyl-methane is heated to a temperature below the boiling-point of benzol with 7 or 8 parts of benzol and 1 part of aluminium chloride, there is formation of diphenyl-methane. Diphenyl, if heated with aluminium chloride, yields benzol and black resinous products. Hexa-methyl-benzine is readily attacked by aluminium chloride at a low temperature. Among the products are penta-methyl-benzine, durol, and carbides less methylated. Durol, if submitted to the same treatment, gives liquid hydrocarbons, trimethyl-benzines, and xylenes. Naphthaline, if heated with a fourth of its weight of aluminium chloride, yields benzol and a mixture of naphthaline hydrides.

Alloys of Indium and Gallium.—Lecoq de Boisbaudran.—These alloys do not decompose water appreciably, and are only very slowly attacked by dilute hydrochloric acid. The melting-points are difficult to determine, because the fluidity increases gradually, the metal remaining for some time in a pasty condition, as if formed of a mixture of perfect liquid with crystalline grains. The melting-point of the most fusible of these alloys lies near 16·5°.

The Polarisation Lightning-rod.—A. d'Arsonval.—A reply to M. Daussin's claims of priority.

Study of the Methods employed for finding the Potential of the Air: Electromotive Force of Combustion.—H. Pellat.—The author recommends for taking the potential of the air a gas-flame burning at the extremity of a metallic jet, insulated and connected with the electrometer. This apparatus brings the needle of the electrometer almost instantly to the potential of the air.

The Decomposition of Salts by Water.—H. Le Chatelier.—The quantity of free acid increases indefinitely with the quantity of salt dissolved. Experiments with mercury sulphate show that the relation between the weight A of free acid and the weight S of the salt dissolved is of the form $A^{1·58} = 4·7\ S$; in other words, analogous to that which Schlœssing has established for the decomposition of calcium bicarbonate, and which has since been verified for magnesium bicarbonate. Experiments with antimony chloride present a very distinct discontinuity; the curves show an abrupt angle, which corresponds to a change in the composition of the precipitate of oxychloride. To represent the total of the experiments made at one and the same temperature two different exponential formulæ are required :—

$$A^{0·8} = k'\ S.$$

$$A^{8} = k''\ S.$$

An elevation of temperature increases the decomposition of the mercury sulphate, which is accompanied with an absorption of heat, and diminishes that of antimony chloride, which is accompanied with a liberation of heat.

The Separation of Titanium from Niobium and Zirconium.—E. Demarçay.—This paper will be inserted in full.

Normal Pyro-tartaric and Succinic Nitriles.—Louis Henry.—It results from the facts laid down in this memoir that in the oxalo-adipic group we find, as to fusibility, the same relations between the nitriles as between the acids themselves; the fusibility increases on passing from an even to an odd term.

On Iodacetone.—MM. de Clermont and P. Chautard.—Iodacetone is a limpid, volatile, corrosive, but not inflammable liquid, of sp. gr. 2·17 at 15°. It is colourless, but turns brown on exposure to light. Heat decomposes it, and it cannot be distilled without alteration even in a vacuum. It is soluble in all proportions in alcohol, ether, benzol, chloroform, and carbon disulphide. Dilute potassa has no action upon iodacetone. It reduces the cupro-potassic reagent energetically.

Formation-heat of Ammonium Glyoxal-bisulphite.—M. de Forcrand.—A thermo-chemical memoir, which does not admit of useful abridgment.

Researches on the Colouring-matters of Leaves: Identity of the Orange-red Colour with Carotine.—M. Arnaud.—The author has obtained the erythrophyll of Bougarel in the form orange-red crystals. He extracts this colour by means of so-called petroleum ether, in which chlorophyll remains insoluble. The substance thus obtained has the same solubility in different solvents as carotine; the same melting-point, the same crystalline form, and the same chemical reactions.

Vol. c., No. 11, March 16, 1885.

Reaction of Bromine with the Chlorides and with Hydrochloric Acid: a New Class of Perbromides.—M. Berthelot.—The author points out the existence of a new group of secondary compounds formed by the addition of bromine to the chlorides, after the manner of the alkaline perbromides which the author has already made known. A solution containing 1 equiv. of hydrochloric acid in 2 litres of liquid dissolved on standing for several days 44·25 grms. bromine, a quantity which surpasses by one-half the solubility of bromine in pure water. A solution of barium chloride almost saturated in the cold dissolved 115 grms. of bromine, or almost four times the weight soluble in the same weight of pure water. A similar solution of barium chloride dissolves twelve times as much iodine as does pure water. These solutions are effected with liberation of heat.

The Solubility of Carbon Disulphide and of Chloroform.—G. Chancel and F. Parmentier.—The solubility of carbon disulphide in water diminishes as the temperature rises. It conducts itself, as far as solubility is concerned, like gases which have no chemical action upon their solvent, though at the same time it forms with water several hydrates of little stability. The law of solubility in water is not the same for chloroform as for carbon disulphide. Whilst the solubility of the latter decreases continuously as the temperature rises, chloroform presents a decreasing solubility from 0° to about 30°, and then increasing again towards its boiling-point.

Electric Differences between Liquids, and on the Part Played by the Air in the Electrometric Measurement of these Differences.—E. Bichat and R. Blondlot.—This memoir does not admit of useful abstraction.

Galvanometers with a Curvilinear Frame.—A. Gaiffe.—The author describes a construction by means of which, for currents of an intensity increasing in arithmetical progression, the needle has its points of equilibrium equidistant on both sides of the scale until about the 70th degree of the circle.

Thermo-chemical Study of Ammonium Fluo-Silicate.—Ch. Truchot.—The author examines the action of silicium fluoride upon ammonium fluoride; that of silicium fluoride upon ammonia; and that of fluosilicic acid upon ammonia.

New Process for Hardening Plaster.—M. Julhe.—The author mixes intimately 6 parts of plaster of good quality with 1 part of fat lime, recently slaked and finely sifted, and uses this mixture like common plaster. He then moistens the object thus formed with a solution of zinc or iron sulphate.

A Monochlorised Monobromised Camphor.—P. Cazeneuve.—On treating the normal α-monochlorised camphor with the theoretical quantity of bromine, the author has obtained $C_{10}H_{14}ClBrO+HBr$ as a semi-liquid yellowish body, which is purified by repeated crystallisation from alcohol.

The Liquid of Fromherz.—E. J. Maumené.—The author has compared two tartaro-cupric liquids, the one prepared with potassa and the other with soda. The first was made up with 41·67 copper sulphate, potassium bitartrate 20·89, and caustic potassa 10·44 grms., made up with water to 1000 c.c. It is of a fine sky-blue, and acts in the known manner upon glucose. The sodic liquid—prepared in the same proportions with pure soda in place of potassa—has no action upon glucose. It is of an intense blue, less azure than the potassic liquid.

Moniteur Scientifique, Quesneville.
Vol. xv., March, 1885.

Industrial Society of Mulhouse.—Session Dec. 10, 1884.—A note was read from MM. Camille Kœchlin and Mathieu Plessy, showing that under certain circumstances alumina can displace ammonia, and, again, that oxalic acid in presence of alumina can displace hydrofluoric acid.

M. Goppelsroeder sent in a long letter showing in what his experiments on the electrolytic formation of oxycellulose differ from those of M. Witz.

Dietsch Bros., of Liepvre, have substituted for fugitive colours others which absolutely resist air and the process of fulling.

The refined pipe-clay of Beneke and Co., of Podersam, was found on examination not absolutely free from grit, and, consequently, not deserving of prize XXXIV.

M. Noelting exhibited a specimen of double antimony-potash oxalate much cheaper than tartar emetic, and capable of being substituted for it in all the operations of dyeing and printing.

M. A. Scheurer mentioned that at the Thann Chemical Works there is prepared a liquid tartrate of antimony and soda.

M. de la Harpe described a series of observations showing that under certain circumstances hydrochloric acid can displace sulphuric acid.

In determining fixed acids in deeply coloured liquids where direct titration is impossible, de la Harpe adds sodium acetate and distils, preferably under greatly reduced pressure, and determines the acetic acid in the distillate. He has remarked also that ammonium hydrosulphate, if it contains thiosulphates, can give with barium chloride in presence of acids barium sulphate.

Session January 14, 1885.—In an obituary notice of the late Gerber-Keller an account is given of the lawsuit by which Renard and Frank succeeded in monopolising the manufacture of magenta in France.

In reading the minutes of the last meeting it was remarked that the favourable judgment of M. Noelting was founded merely upon laboratory experiments, and required confirmation on the large scale. Several members of the Committee pointed out that for complicated styles involving the use of colours easily affected by acids antimony oxalate might be dangerous on account of the liberation of acid potassium oxalate. In dyeing, however, where the bath may be progressively neutralised, the oxalate can be used without inconvenience.

H. Kœchlin, to whom we owe the process of mordanting with chromium oxide in an alkaline solution, demonstrated its behaviour with the ordinary colouring matters. Various other mordants were added,—alum, alum and chrome-alum, chrome alum alone, tin crystals, gelatin. A part of the cloth was then steamed, and half of each swatch soaped at 60°. The mordanting was effected by two passages, with an interval of two hours in—

1 Chromium acetate at 16° B.
3 Water.
2 Caustic soda at 38° B.
$\frac{1}{16}$ Glycerin.

The dyeing was effected at a temperature reaching 80°. The following colours were not improved by one of the additions mentioned:—Magenta, Poirrer's violet, malachite green, phosphine, gallocyanine, methylene-blue, orchil, logwood, nitro-alizarin, anthracene-blue, Persian berries, quercitron bark, cœruleine. The colours which require an addition of chrome-alum are—Bismarck brown, Coupier grey, Victoria blue, cochineal garnets (especially dark shades), blue eosine, Nicholson blue. The colours which were improved by the addition of 25 per cent of tin-crystals are—Ponceau 3 R, Bordeaux S, roccelline, rose Bengale, eosine, orange II., extract of indigo, cochineal, Persian berries. All these are rendered brighter and faster by steaming. Those which then bear soaping at 60° are—Bismarck brown, malachite green, Victoria blue, gallocyanine, cochineal, logwood, alizarin, nitro-alizarin, berrries, quercitron bark, cœruleine, eosine, rose Bengale. Three colouring matters yielded negative results—Auramine, safranine, and anthracene-blue. The most important result was that of Ponceau 3 R with an equal weight of chrome-alum. This red on steaming is rendered fast enough to bear soaping at 75°.

A. Scheurer read a paper on a mordant of alumina used as a discharge on vat-blues. He prints upon the blue a mixture of aluminium chloride and potassium bichromate thickened with starch, and steams for a minute in Mather and Platt's apparatus. The discharge is perfect and the alumina is fixed. The cloth is washed, dyed in alizarin, and soaped. The red is rather dull, probably because decomposition-products of indigo are fixed along with the alizarin-lake.

M. Kerten proposes, in fixing colours with tannin, to substitute for tartar emetic the precipitated oxide of antimony. The colours are fixed as well, and there is a considerable economy.

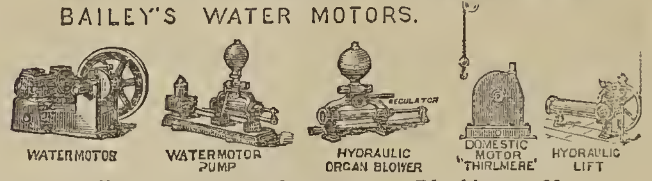
NOTES AND QUERIES.

⁂ Our Notes and Queries column was opened for the purpose of giving and obtaining information likely to be of use to our readers generally. We cannot undertake to let this column be the means of transmitting merely private information, or such trade notices as should legitimately come in the advertising columns.

Watered Lard Branded "Pure."—I am an analyst, and have had eleven years' experience in testing the purity of lard. I have lately tested seven of the leading brands of lard, all bearing the words "Pure" or "Warranted Pure." Of the seven only two were free from water, the other five contained from 1½ to 2¾ per cent of water, and one of them, in addition to water, contained gelatinous matter to such an extent that I could not get the lard to clear even after half an hour's exposure to a temperature of 212°. The water in the fine samples had been incorporated with the lard by stirring during cooling. Nothing is easier to accomplish than to send out lard absolutely free from water. If only 1 p.c. of water is found the presumption is that it has been added to lower the cost and to add to the refiner's profit or to enable him to undersell his competitors. I hope that chemists occupying the positions of public analysts will at once extinguish this method of sophistication while it is in its infancy.—W. BROWN, 3, Hereford Road, Seaforth, Liverpool, March 25, 1885.

MEETINGS FOR THE WEEK

MONDAY, 6th.—Royal Institution, 5. General Monthly Meeting.
TUESDAY, 7th.—Pathological, 8.30.
WEDNESDAY, 8th.—Microscopical, 8.
FRIDAY, 10th.—Astronomical, 8.
—— Quekett Club, 8.


WATERMOTOR
WATERMOTOR PUMP
REGULATOR
HYDRAULIC ORGAN BLOWER
DOMESTIC MOTOR "THIRLMERE"
HYDRAULIC LIFT

THE CHEMICAL NEWS.

Vol. LI. No. 1324.

CONTRIBUTIONS TOWARDS THE SOLUTION OF THE CHEMICAL CONSTITUTION OF ISATIN.*

By H. KOLBE.

(Concluded from p. 159).

Action of Concentrated Nitric Acid on Isato Acid.—Nitro-Isato Acid.

Nitric acid of 1·48 sp. gr. dissolves isato acid readily without heating or perceptible evolution of gas, and is thereby coloured red, and gives off ruddy fumes. On standing for several hours the whole solidifies to a homogeneous crystalline mass. After being freed from the mother-liquor by suction through glass-wool, and re-crystallised from a mixture of equal parts of absolute alcohol and acetone, the compound is obtained in beautiful mother-of-pearl glancing plates. Its composition gives the formula $C_8H_4N_2O_5$, and it is thererefore a nitro-isato acid,—

$$\left.\begin{matrix}C_6H_3\\NO_2\\N\end{matrix}\right\}CO.COOH.$$

On the first mother-liquor from the crystals being mixed with water, a voluminous precipitate subsided, which, after suction, as before, was also re-crystallised from a mixture of alcohol and acetone. The solution deposited, upon cooling, similar crystals to those above, and these were subjected to analysis.

I. 0 260 grm. of the acid, after drying over H_2SO_4, gave 0·438 grm. CO_2 and 0·052 grm. H_2O.

II. 0·132 grm. of the same substance gave, at 11° and 760 m.m. bar., 15·0 c.c. N.

	Calculated for		Found.
C_8	96	46·15 p.c.	45·96 p.c.
H_4	4	1·92 ,,	2·22 ,,
N_2	28	13·46 ,,	13·55 ,,
O_5	80		
	208		

The nitro-isato acid melts, under decomposition, between 220° and 230°, is almost insoluble in water, difficultly soluble in alcohol, and insoluble in ether, and crystallises from a mixture of equal parts of alcohol and acetone in colourless mother-of-pearl glancing plates. Addition of water to the solution of the acid in alcohol, or in the mixture of alcohol and acetone, precipitates it.

The chemical behaviour† of nitro-isato acid corresponds generally with that of isato acid, the former being, however, more stable towards water, acids, &c., than the latter. Just as isato acid yields with those reagents anthranilic acid, so does the nitro-derivative give a nitro-anthranilic acid, which corresponds with one of the two known compounds of this composition, and therefore explains the function of the nitroyl in the original nitro-isato acid.

If the latter be evaporated along with aqueous hydrochloric acid, carbonic acid is evolved; the residue (which contains no hydrochloric acid in chemical combination) yields, upon re-crystallisation from alcohol, a strong acid which forms yellow needles, is difficultly soluble in water, easily in alcohol and ether, and not at all in chloroform and benzol; it melts between 265° and 270° under decomposition.

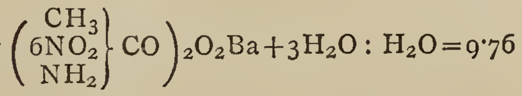
The same acid is formed, although more slowly, by continued boiling of a mixture of water and nitro-isato acid. As is shown by the properties of the product—as given above—but especially by the composition of the baryta salt prepared from it (see the analysis of the same below), we have here to do with the nitro-anthranilic acid already obtained in a different way by Hübner* and Griess,† the so-called M-nitro-O-amido-benzoic acid or ε-nitro-amido-benzoic acid).

The barium salt prepared from the above by means of baryta water, precipitation of the excess of barium by carbonic acid, and evaporation of the filtrate, crystallises in sharp, reddish-yellow needles. According to the analysis, it is nitro-amido-benzoic of barium + 3 mol. water of crystallisation.

I. 0·2025 grm. of the air-dried substance lost at 110° 0·020 grm. H_2O = 9·87 per cent H_2O.

II. 0·165 of the same substance lost at 110° 0·015 grm. H_2O = 9·7 per cent.

III. 0·1825 grm. of the dehydrated substance gave 0·0854 grm. $BaSO_4$ = 0·0502 grm. Ba = 27·50 per cent Ba.

Calculated for 

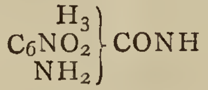
$$\left(\left.\begin{matrix}CH_3\\6NO_2\\NH_2\end{matrix}\right\}CO\right)_2O_2Ba+3H_2O : H_2O=9{\cdot}76$$

per cent.

The water-free salt contains Ba = 27·45 per cent.

If nitro-isato acid be suspended in a small quantity of warm water, and ammonia added, it is quickly dissolved. The solution solidifies soon thereafter to a yellow crystalline mass, which is easily obtained pure by pressing and recrystallising from absolute alcohol to which some acetone has been added. The new compound, the amide of the above nitro-anthranilic acid, crystallises in yellow needles, is difficultly soluble even in hot water and in boiling alcohol, but easily in acetone.

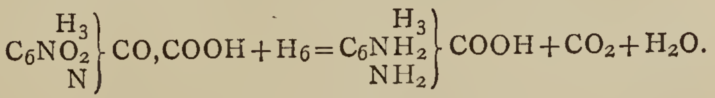
It decomposes at a temperature between 200° and 210°. 0·236 grm. of the compound dried over H_2SO_4 gave at 9° and 760 m.m. bar., 45 c.c. N. N = 22·93 per cent.

Calculated for 

$$C_6\left.\begin{matrix}H_3\\NO_2\\NH_2\end{matrix}\right\}CONH : N=23{\cdot}20 \text{ per cent.}$$

Reduction of Nitro-Isato Acid.

On treating nitro-isato acid with tin and tolerably concentrated hydrochloric acid, under gentle warming, much carbonic acid besides hydrogen escaped, which led one to suppose that a reduction product of the above nitro-amido-benzoic acid was formed, and this was verified by the examination of the resulting solution. In this there was contained the hydrochloric acid salt of a diamido-benzoic acid, which, from its relation to the above nitro-anthranilic acid, may be termed amido-anthranilic acid. Its formation is shown by the following equation:—



$$C_6\left.\begin{matrix}H_3\\NO_2\\N\end{matrix}\right\}CO,COOH+H_6=C_6\left.\begin{matrix}H_3\\NH_2\\NH_2\end{matrix}\right\}COOH+CO_2+H_2O.$$

The above solution was first freed from tin by means of sulphuretted hydrogen, and then, in order to prevent decomposition setting in during the subsequent evaporation, a few crystals of acid sulphite of soda were added.‡ Notwithstanding this, the solution became brown-coloured, and deposited when sufficiently concentrated, a salt likewise dark in colour, which after pressing was re-crystallised from hot water containing a little hydrochloric acid. The pale-yellow salt thus got, crystallising in small columns, has the composition of hydrochloric acid-diamidobenzoic acid: $C_6H_3(NH_2)_2COOH.2HCl$.

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* A Paper read before the Royal Society, March 12, 1885.

† The chemical behaviour of nitro-isato acid towards water, hydrochloric acid, and ammonia, and also towards reducing agents, has been investigated by Dr. Bellmann since the death of the author.

* *Ann. Chem. Pharm.*, 195, 21.

† *Ber. Berl. Chem. Ges.*, 11, 1730.

‡ Compare Griess regarding his investigation upon diamidobenzoic acid. *Ann.*, 154, 325.

0·235 grm. of the salt, dried over sulphuric acid, gave on precipitation with nitrate of silver 0·302 grm. AgCl = 31·79 per cent Cl; calculated = 31·51 per cent.

The sulphuric acid-diamidobenzoic acid,—

$$C_6H_3(NH_2)_2COOH.SO_2(OH)_2,$$

prepared from the above salt, crystallises from water in hard transparent prisms, and has, after drying over sulphuric acid, the composition given above.

0·163 grm. substance gave on precipitation with chloride of barium 0·153 grm. $BaSO_4$, corresponding to 32·2 per cent SO_3; calculated 32·00 per cent.

0·324 grm. of the salt gave 31·6 c.c. N at 13° and 735 m.m. pressure = 11·13 per cent N; calculated 11·20 per cent N.

Attempts to isolate the free diamidobenzoic acid from the above salts were unsuccessful; the solutions of the latter became, on addition of ammonia, of a deep indigo-blue colour. We have here in all probability before us, in the above compounds, salts of the α-diamidobenzoic acid described by Griess,[*] whose sulphuric acid compound crystallises free of water, and which is also obtained direct from the above described ε nitro-amidobenzoic acid by reduction.

Action of Nitrous Acid on Isato Acid.

Into water containing finely-powdered isato acid in suspension, and kept at about 70°, nitrous acid was led; carbonic acid and nitrogen were evolved with foaming. From the hot filtered solution long felt-like needles separated out on cooling, and these, at first yellowish, were finally obtained colourless by several re-crystallisations from hot water to which animal charcoal has heen added. This compound, a strong acid, is almost insoluble in cold water, tolerably soluble in hot, and very readily in alcohol, ether, and chloroform; it melts at 228° and can be sublimed if cautiously heated. Its water solution is coloured bloodred by addition of chloride of iron. According to analysis, it has the composition $C_7H_5NO_5$.

0·1804 grm. substance gave 0·3037 grm. CO_2 (0·0828 grm. C) and 0·0491 grm. H_2O (0·0055 grm. H).

0·1894 grm. substance gave at 13° and 753 m.m. pressure, 12·3 c.c. N = 0·0144 grm. N.

	Calculated.		Found.
C_7	84	45·90 p.c.	45·91 p c.
H_5	5	2·73 ,,	3·02 ,,
N	14	7·65 ,,	7·60 ,,
O_5	80	43·72 ,,	
	183	100·00	

The melting-point and other properties of the compound leave no doubt that it is the carefully investigated α-nitrosalicylic acid of Hübner—$C_6H_3(NO_2)(OH)COOH$. Its ethyl ether, prepared by means of hydrochloric acid and alcohol, crystallises in long colourless needles which melt at 95° and, according to the analysis, have the composition $C_6H_3(NO_2)(OH)COOC_2H_5$ (51·3 per cent C and 4·37 per cent H found; 51·2 per cent C and 4·27 per cent H calculated). The formation of α-nitro-salicylic acid from isato acid, as described above, is easily explained upon the supposition that the anthranilic acid (amidobenzoic acid) generated from the latter is nitrated by the nitrous acid, and that in this nascent nitro-amidobenzoic acid the amide is replaced by hydroxyl.

$$\underset{\text{Nitro-amido-benzoic acid.}}{C_6H_3(NO_2)(NH_2)COOH} + NOOH =$$

$$= N_2 + H_2O + \underset{\text{Nitro-salicylic acid.}}{C_6H_3(NO_2)(OH)COOH}$$

The foregoing research explains the behaviour of isato acid substantially only in one direction. Other experiments are now being made by means of which the changes induced in this compound by suitable oxidising and reducing agents shall be made clear, in order thereby to gain new foundations for the right perception of the chemical constitution of isatin and compounds derived from it.

We possess in the substance obtained by the oxidation of indigo, and named by me isato acid, a nitrogen compound which seems to be specially fitted to shed light upon the question whether nitrogen can act not only as a di-, tri-, tetra-, and penta-valent element (as in nitric oxide, ammonia, nitrous acid, and nitric acid), but also as a monovalent one. The mode of formation and the chemical behaviour of this isato acid gain—through the conception that it is benzoylic acid, in which one of the five phenyl hydrogen atoms is replaced by an atom of monovalent nitrogen, and through the further supposition that isatin is its corresponding aldehyd—such a simple and, from all points of view, satisfactory explanation, that only one already prejudiced by the idea that nitrogen can only be trivalent can feel himself satisfied by the supposition that the molecular weight of isato acid must be doubled, i.e., *that it is a dibasic acid. None of the facts which up till now I have discovered support this hypothesis; on the contrary, by the supposition that isato acid contains* 1 *atom of monovalent nitrogen as substitute for* 1 *atom of hydrogen, they all obtain the simplest and least strained explanation in such a degree that, in the publication of my research on isatin and isato acid and their derivatives, I have not discussed the question whether the nitrogen in them may possibly be polyvalent.*

A NEW METHOD OF SEPARATING NICKEL AND COBALT.

By M. ILINSKI and G. VON KNORRE.

THE solution containing nickel and cobalt as sulphate or chloride (iron and chromium must *not* be present) is mixed with a few c.c. of free hydrochloric acid. There is then added to the liquid, previously heated, a hot solution of nitroso-β-naphthol in hot acetic acid. The precipitate is allowed to subside, and when cold the liquid is tested with a further quantity of the nitroso-naphthol solution. If the precipitation is complete the deposit is filtered off after some hours, and washed with hydrochloric acid at 12 per cent, first cold and then warm, until the nickel is removed, and lastly with hot water. As the precipitate is very bulky the filter used must not be too small; in other respects the washing is easy. To the dry precipitate are added a few knife-points full of crystalline oxalic acid, free from ash; the filter is folded up and incinerated cautiously in a tared Rose's crucible at a gradually increasing heat. It is then ignited in a current of hydrogen, and weighed as metallic cobalt. In the filtrate the nickel is thrown down, apparently quantitatively, by heating with potassium hydroxide after the bulk of the acetic acid has been expelled by heat. It is preferable, however, to precipitate nickel and cobalt together in an aliquot part of the solution by means of potassium hydroxide, and to weigh the metals after reduction in a current of hydrogen. In another portion of the solution the cobalt is determined as above, and the nickel is found as difference.

The authors give a few experiments showing the sensitiveness of the reaction for cobalt:—

1. According to Vortman 1 c.c. of a solution of cobalt (containing 0·000059 grm. Co), mixed with potassium nitrite and acetic acid, gives a distinct turbidity in half an hour, and after two hours a faint precipitate of Fischer's salt; 1 c.c. of the same solution mixed with acetic and hydrochloric acid gave, on the addition of an acetic solution of nitroso-naphthol, an immediate brick-red turbidity, and in a few minutes a brick-red deposit.

2. Five c.c. of the same solution mixed with 5 c.c. of a solution of nickel (0·0295 grm. Ni) gave, on the addition of potassium nitrite and acetic acid, no turbidity, even after three hours. After twenty-four hours there appeared a slight yellow precipitate; 5 c.c. of the same solution

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[*] *Journ. Prakt. Chem.*, [2], 5, 237.

with 10 c.c. nickel solution (0·021 grm. Ni) behaved, with solution of nitroso-naphthol, as in Exp. 1.

3. Five c.c. of a nickel solution (0·0105 Ni) with 0·2 c.c. of a cobalt solution (0·00004 Co) gave, on the addition of a solution of nitroso-β-naphthol, an immediate brick-red turbidity, and after some time red flakes were deposited.

The authors are studying the behaviour of the nitroso-naphthols with other metals.—*Berichte der Deutsch. Chem. Gesellschaft.*

A CATALOGUE OF CHEMICAL PERIODICALS.*

By H. CARRINGTON BOLTON, Ph.D.,
Professor of Chemistry in Trinity College, Hartford, Conn.

Introductory.—This Catalogue is intended to contain the titles of the principal chemical periodicals of all countries, from the rise of this literature to the present day. The tendency in serial publications, especially in those of earlier date, to include in a single journal many departments of Science, makes it difficult for the bibliographer to draw the line accurately between periodicals devoted to given sciences. Therefore any attempt to classify chemical periodicals is liable, on the one hand, to too great exclusiveness to satisfy the needs of some, and, on the other, to too great comprehensiveness and consequent voluminosity.

Chemistry is so commonly treated in periodical literature together with the kindred sciences of physics and of pharmacy, that strictly speaking a full bibliography of chemical periodicals should include all those devoted to the two sciences just named. Moreover, there is a large and growing number of technical journals dealing with a special branch of chemical technology, such as brewing, dyeing, gas-making, sugar-refining, &c.; and these also should be included in any bibliography claiming to be exhaustive. The following catalogue is, however, confined to the more limited plan, for two reasons:—first, because it is prepared for the convenience of chemists needing a reasonably full list of chemical journals for use in compiling indexes to special topics, in accordance with the scheme of co-operative indexing in charge of a committee of the American Association for the Advancement of Science; and second, because my "Catalogue of Scientific and Technical Periodicals, 1665 to 1882," published by the Smithsonian Institution, includes works in every department of pure and applied science; and to this comprehensive work we refer librarians and others seeking a wider range. The data in the following pages have been drawn in great measure from the larger catalogue just named; the works have been brought down to a later date, and society journals have been introduced.

That no bibliography of periodicals which can be classed as chemical will contain all the literature of chemistry goes without saying: chemical papers are unfortunately widely scattered in society publications and in serials devoted to general science; to include all these is of course out of the question, but a few have been admitted to this list. For a more complete bibliography we refer for society journals to the "Catalogue of Scientific Serials" of Mr. S. H. Scudder (Cambridge, 1879, 8vo.), and for journals of general science to our own "Catalogue" already mentioned.

Plan of Catalogue.—The arrangement of titles is strictly alphabetical, the articles and the adjective *New* alone excepted. The different titles borne by a periodical at different periods are arranged in chronological order under the first or earliest title.

Cross-references have been freely introduced, and are of three kinds: 1st, from the later to the first title of a periodical which has undergone changes in title; 2nd, from short titles in common use to the accurate bibliographical designations; 3rd, from the names of editors to the periodicals conducted by them. Besides these, in the case of societies, references are made from the cities in which the societies are located, and from the proper designation of the societies to the titles of the journals published by them.

EXPLANATION OF SIGNS.

+ Following a date signifies current at the date in question.
|| Following a date signifies publication discontinued.

ACADEMIE DES SCIENCES, Paris.
See Comptes-rendus hebdomadaires des séances [&c.]
ACADEMIE IMPERIALE DES SCIENCES DE ST. PETERSBOURG.
See Mélanges physiques et chimiques [&c.].

1. AFHANDLINGAR I FYSIK, KEMI OCH MINERALOGI Utgiſne af W. Hisinger och J. Berzelius. 6 vols. 8vo. Stockholm, 1806-'18. Vol. I., 1806; II., 1807 III., 1810; IV., 1815; V., VI., 1818.

2. AGENDA DU CHIMISTE. 16mo. Paris, 18**-'82.+

AKADEMIE DER WISSENSCHAFTEN - - - - WIEN.
See Monatshefte für Chemie.
ALBERTONI, P.
See Revista di chimica e farmaceutica.

3. ALLGEMEINE CHEMIKER ZEITUNG. Central-Organ für Chemiker, Techniker, Ingenieure, Maschinenbauer, Fabrikanten chemisch-technischer Apparate. Correspondenzblatt chemisch-technischer und Gewerbe-Vereine. Chemisches Central-Annoncenblatt. Herausgegeben von G. Krause. 8 vols, 4to. Cöthen, 1877-'84.+
In 1879 the Prefix ALLGEMEINE *was dropped.*

4. ALLGEMEINE CHEMISCHE BIBLIOTHEK DES NEUNZEHNTEN JAHRHUNDERTS. Herausgegeben von J. B. Trommsdorff. 5 vols., 8vo. Erfurt, 1801-'05.

ALLGEMEINE NORDISCHE ANNALEN DER CHEMIE.
See Nordische Blätter für Chemie.

5. ALLGEMEINES JOURNAL DER CHEMIE. Herausgegeben von Alex. Nic. Scherer. 10 vols., 8vo. Leipzig, 1798-1803.

Continued under the title:

[a] Neues allgemeines Journal der Chemie, von Klaproth, Hermbstädt, Scherer, J. B. Richter, J. B. Trommsdorff, herausgegeben von Ad. Ferd. Gehlen. 8 vols., 8vo. Leipzig, 1803-'06.

Continued under the title:

[b] Journal für die Chemie [*from.* vol. IV] und Mineralogie, von Bucholz, Crell, Hermbstädt, Klaproth, Richter, Ritter, Trommsdorff, herausgegeben von A. F. Gehlen. 9 vols., 8vo. Berlin, 1806-'10.

Continued under the title:

[c] Journal für Chemie und Physik, in Verbindung mit J. J. Bernhardi, J. Berzelius, C. F. Bucholz, L. von Crell, A. F. Gehlen [*and others*], herausgegeben von J.S.C. Schweigger. 69 vols., 8vo. Nürnberg, 1811-'33.

Changes in the title as follows:

1st Series, vols. I.-XXX., 1811-'20, *also under the title,* Beiträge zur Chemie und Physik.
2nd Series, vols. XXXI.-LX., 1821,-'30, *also under the title* Jahrbuch der Chemie und Physik herausgegeben von Schweigger und Meinecke.
3rd Series, vols. LXI.-LXIX., 1831-'33, *also under the title* Neues Jahrbuch der Chemie und Physik. *From* 1829, *edited by* Fr. W. Schweigger-Seidel.
United in 1834 *with the* Journal für technische und oekonomische Chemie, *and continued under the title:*

[d] Journal für praktische Chemie, herausgegeber, von Otto Linné Erdmann, F. W. Schweigger-Seidel (und R. F. Marchand). [*From* 1853. *edited by* O. L. Erdmann *and* Gustav Werther.] 108 vols., 8vo. Leipzig, 1834-'69,

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* Advance-proofs from the *Annals of the New York Academy of Sciences.*

[e] Neue Folge. Herausgegeben von Hermann Kolbe. [*From* 1879 *by* H. Kolbe *and* Ernst von Meyer.] 30 vols., 8vo. Leipzig, 1870-'84.+

Sach- und Namen-Register zu Band I.-XXX. Leipzig, 1844.
Ditto, ditto, Band XXXI-LX. Leipzig, 1854.
Ditto, ditto, bearbeitet von Friedrich Gottschalk. Band LXI.-XC. Leipzig, 1865.
Ditto, ditto, Band XCI.-CVIII. Leipzig, 1871.

(To be continued).

NOTES ON THE HÜBL METHOD FOR THE EXAMINATION OF OILS AND FATS.

By RUSSELL W. MOORE.

DURING the past year the analysis of butter and other fats has received much attention in the chemical laboratory at Princeton. The various methods were subjected to rigid tests, and other fats and oils were also examined by the same methods, in order to ascertain whether they could be used to adulterate butter without fear of detection. The result of this extended examination has been a decided verdict in favour of Reichert's process.

The method of Hehner was found to be liable to pronounce as genuine butter mixtures of butter with cocoanut oil, while that of Köttstorfer is unreliable from the fact that mixtures of oleomargarine and cocoanut oil were made in such a manner as to come within the prescribed limits.*

Recently the method of Hübl,† based on the amount of iodine absorbed by oils and fats, has been examined. All oils and fats consist of various proportions of the glycerides of the fatty acids of the acetic, acrylic, and tetrolic series. These glycerides are acted upon differently by iodine according to the series to which they belong, the acetic series remaining indifferent, while each molecule of the acrylic unites with two atoms of iodine, and each molecule of the tetrolic series with four.

Although the acids behave thus differently towards iodine, the amount of this element absorbed by any given oil is constant. Thus by treating any oil or fat with an excess of iodine, and, after the lapse of some time, estimating the excess by a standard solution of hyposulphite of sodium, the amount of iodine absorbed can be obtained.

By this process Hübl has examined a large number of oils and fats, and has obtained results varying from Japanese wax, which absorbs but 4·5 grms. of iodine per 100 grms., to linseed oil, which will absorb as high as 160 grms.

The following results were obtained in strict accordance with the directions laid down by the author in the original article. The process was found to be most convenient and expeditious, and the transition point of the final titration is extremely sharp. The author recommends the following amounts to be taken for analysis:—

Drying oils	0·2 to 0·3 grm.	
Non-drying oils	0·3	0·4 ,,
Solid fats	0·8	1·0 ,,

My experience has been that it is best to take the lowest amounts recommended, as an excess of iodine is thus secured.

The following results were obtained by duplicate analyses, and the "iodine figures" or amounts of iodine absorbed by 100 grms. of oil for the most part agree closely with those given by Hübl:—

Linseed oil	155·2
Poppy oil	134·0
Cotton-seed oil	108·7
Rape-seed oil	103·6
Benne oil	102·7
Sweet almond oil	98·1
Mustard-seed oil	96·0
Peanut oil	87·4
Olive oil	83·0
Lard (melted in laboratory) ..	61·9
Palm oil	50·3
Oleomargarine No. 2	50·0
,, No. 3	50·0
Butter I.	32·8
,, II.	19·5
,, III.	38·0
Cocoanut oil..	8·9

The process, while furnishing an excellent means for detecting mixtures of some oils, as, for example, olive oil with cotton-seed or benne oils, is of no practical value for the examination of butter for foreign fats; since oleomargarine and lard, the ordinary substitutes for butter, have iodine figures considerably higher than that of butter, while that of cocoanut oil lies much below. Thus a mixture might be made of lard and cocoanut oil, or oleomargarine and cocoanut oil, which would have the same iodine figure as butter. In proof of this the following mixtures were made and examined:—

I.	Lard..	40 per cent	Iodine figure, 32·2.
	Cocoanut oil ..	60 ,,	
II.	Oleomargarine .	55 ,,	,, ,, 35·5.
	Cocoanut oil ..	45 ,,	
III.	Butter I.	50 ,,	,, ,, 35·4.
	Oleomargarine .	27·5 ,,	
	Cocoanut oil ..	22·5 ,,	

The specific gravity of the cocoanut oil used was 0·9167 at 37·7° C., which is sufficiently high to bring the mixtures above the specific gravity of 0·911, which is taken to be that of butter.

The amount of iodine absorbed by different butters varies widely. In eight samples Hübl found a maximum figure of 35·1, and a minimum of 26·8. He also observes that when the fat has undergone any serious decomposition the iodine figures will fall much lower. The truth of this remark is seen in Butter II., which was in a very advanced stage of decomposition, and gave figures considerably lower than the lowest obtained by Hübl.

A comparative view of the results of the examination of several samples by the four different methods is here given:—

	Hehner.	Köttstorfer.	Hübl.	Reichert
*Oleomargarine 2	95·56	197·4	50·0	0·6
* ,, 3	—	195·0	50·0	0·4
*Butter II. ..	86·01	227·0	19·5	13·25
* ,, III. ..	86·49	224·0	38·0	13·1
Mixture III. ..	89·50	227·5	35·4	8·7

The samples starred were examined by the Hehner, Reichert, and Köttstorfer methods by Prof. Cornwall, and the results embodied by him in his Report to the New Jersey State Board of Health for 1884.

Butter II. was examined by these three processes while fresh, but not by the Hübl process until it had undergone serious decomposition.

Thus cocoanut oil, as in the case of the Hehner and Köttstorfer methods, would also rob that of Hübl of any practical value in the examination of butters, while the claim of the Reichert process to be the only one to give reliable results remains unimpaired.—*American Chemical Journal* (Vol. VI., No. 6).

New Falsification of Beer.—P. Guyot (*Journ. Pharm.*) has detected methyl-orange in a suspected sample.

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* CHEMICAL NEWS, December 5th, 1884.
† *Dingler's Polytechnisches Journal*, 253—281, and abstracted in *American Chemical Journal*, November, 1884.

PROCEEDINGS OF SOCIETIES.

PHYSICAL SOCIETY.

Ordinary Meeting, March 28th, 1885.

Prof. Guthrie, President, in the Chair.

The President announced that the meeting on May 9 would be held at Bristol; further particulars would be communicated to the members.

Mr. Hawes was elected a member of the Society.

The following papers were read:—

"*On Calculating Machines*," by Mr. Joseph Edmondson. Calculating machines are of two classes, the automatic and the semi-automatic. The former were invented by Mr. Charles Babbage between 1820 and 1834, and were designed mainly for the computation of tables. The difficulties against which this inventor contended and the perseverance he displayed in the construction of part of the "difference-engine" he had imagined are now a matter of history. On account of the great cost and high degree of complexity of this machine it was never completed, and the calculating machines of the present day belong to the semi-automatic class, the first example of which is found in a rough and incomplete instrument by Sir Samuel Moreland, in 1663. From 1775 to 1780 the Earl of Stanhope invented machines which were a great advance upon those of Sir S. Moreland. In these is found the "stepped reckoner," the basis of all modern instruments. This "stepped reckoner" was improved by M. Thomas de Colmar, who in 1851 produced a machine which is now largely in use. This machine, somewhat improved in detail and construction, is now made by Mr. Tate, of London, and Mr. Edmondson has patented a modification in which the form of the instrument is circular, by which means an endless instead of a limited slide is obtained. A collection of various valuable instruments, which had been kindly lent for the occasion, were exhibited.

A discussion followed, in which General Babbage, Mr. Tate, Prof. McLeod, Dr. Stone, the Rev. Prof. Harley, Mr. Whipple, Prof. Ayrton, and other gentlemen took part.

"*On the Structure of Mechanical Models, illustrating some Properties in the Ether*," by Prof. G. F. Fitzgerald. The author had recently constructed and described before the Royal Society of Dublin a model illustrating certain properties of the ether (*Nature*, March 26). This model was one-dimensional, but the author now showed how a tri-dimensional model might be imagined, though probably mechanical difficulties would render its actual construction impossible. Each element of the ether is to be represented by a cube, on each edge of which there is a paddle-wheel. Then on any face of the cube there will be four paddle-wheels. Now, if any opposite pair of these rotate by different amounts they will tend to pump any liquid in which the whole is immersed into or out of the cube, and if the sides of the cube be elastic there will be a stress, which will tend to stop this differential rotation of the wheels. If, however, the other pair rotate by different amounts they may undo what the first pair do, and thus the stress will depend on the difference between the differential rotations of these opposite pairs of wheels. If η represent the angular rotation of one pair, and ζ that of the other, the stress will depend upon—

$$\frac{d\eta}{dx}-\frac{d\zeta}{dy}.$$

In order that these four wheels may not similarly work with any other wheel it is necessary to place diaphragms dividing the cube into six cells, each a pyramid standing on a face of the cube. They must be so made that liquid may not be able to pass from one cell to another through the diaphragm or beside the paddle-wheels; to effect this the floats on the paddle-wheels would have to be drawn down while passing the diaphragms. Thus the energy of distortion of such a medium would depend upon—

$$\left(\frac{d\zeta}{dy}-\frac{d\eta}{dz}\right)^2+\left(\frac{d\xi}{dz}-\frac{d\zeta}{dx}\right)^2+\left(\frac{d\eta}{dx}-\frac{d\xi}{dy}\right)^2.$$

And Maxwell has shown that this is also true for the ether. The faces of the cubes should be filled up with diaphragms, past which the paddles should pump liquid, and whose elasticity should be the means of storing electrostatic energy in the medium. The most complicated results follow from supposing the faces of the cubes of which the medium is constructed to have different elasticities. Such a structure represents a crystalline medium, and vibrations would be propagated in it according to laws the same as those regulating the transmission of light in crystalline media. If the cubes were twisted the structure would be like that of quartz or other substances rotating the plane of polarisation. To represent magnetic rotation of the plane of polarisation it would be necessary to introduce some mechanism connecting the ether with matter. The author, in conclusion, insisted upon a view which regards the vibrations constituting light to be of the nature of alterations of structure, and not of displacements executed in a medium possessing the properties of an elastic jelly.

At the close of the meeting the following instruments were exhibited and described in a conversational manner by their makers.

A Chronobarometer and a Chronothermometer, by Mr. Stanley. These instruments consisted of clocks regulated by pendulums, formed in the first instrument of a mercurial barometer, and in the second of a similar barometer enclosed in a hermetically-sealed air chamber, the enclosed barometer thus acting as an air-thermometer. Increase of pressure in the one case and of temperature in the other causes the mercury to rise, and thus accelerates the pendulum. By the gain or loss of time the mean pressure or temperature can be calculated for any period.

A Heliostat and a Galvanometer, by Mr. Conrad W. Cooke. The galvanometer is intended to show the internal current in a cell. The battery plates are in two cells connected by four glass tubes in multiple arc coiled round an astatic needle. The glass work is by Mr. Gimingham.

A Spherometer, by Mr. Hilger, was made of aluminium, and combined lightness with rigidity. By an electrical contact, the maker asserted that measurements could be made to one-millionth part of an inch.

Col. Malcolm exhibited a Spectroscope and a Binocular Field-Glass, in which the two eye-pieces were separately adjustable.

Dr. Watts exhibited a simple modification of a Quadrant Electrometer.

ROYAL INSTITUTION OF GREAT BRITAIN

General Monthly Meeting, Monday, April 6, 1885.

The Hon. Sir William R. Grove, D.C.L., LL.D., F.R.S., Manager and Vice-President, in the Chair.

The following gentlemen were elected Members of the Royal Institution:—James Stewart Hodgson and Henry W. Wimshurst.

The following arrangements for the Lectures after Easter were announced:—

Professor Arthur Gamgee, M.D., F.R.S.—Eight Lectures on Digestion and Nutrition; on Tuesdays, April 14 to June 2.

Professor Tyndall, D.C.L., LL.D., F.R.S., M.R.I.—Five Lectures on Natural Forces and Energies; on Thursdays, April 16 to May 14.

Professor C. Meymott Tidy, M.B., F.C.S., M.R.I.—Three Lectures on Poisons in relation to their Chemical Constitution and to Vital Functions; on Thursdays, May 21, 28, June 4.

William Carruthers, Esq., F.R.S.—Four Lectures on Fir-trees and their Allies) in the Present and in the Past; on Saturdays, April 18, 25, May 2, 9.

Professor William Odling, M.A., F.R.S., M.R.I.—Two Lectures on Organic Septics and Antiseptics; on Saturdays, May 16, 23.

Rev. C. Taylor, D.D.—Two Lectures on A Lately Discovered Document, possibly of the First Century, entitled "The Teachings of the Twelve Apostles," with Illustrations from the Talmud; on Saturdays, May 30, June 6.

PHILOSOPHICAL SOCIETY OF GLASGOW.

March 18, 1885.

Address by Mr. J. J. Coleman, F.I.C., F.C.S., President of the Chemical Section, "*On the Liquefaction of Gases and other Effects of Extreme Cold, and on some Phenomena of High Temperature.*"

Within the last seven years it has been proved that all gases, including atmospheric air, can be reduced to the liquid or solid state by reducing their temperature sufficiently low, the operation being in some cases assisted by compressing them so as to approximate their particles before subjecting them to the influence of extreme cold. Theoretically, it is to be inferred that the abstraction of heat is much more effectual than compression, for in proportion as the absolute temperature decreases they decrease in bulk, so that before absolute zero is reached (which on Fahrenheit thermometer is −461°, or Centigrade thermometer −273°) they should either liquefy or become solid. Although Faraday employed compression as well as cooling in his earlier investigations upon the liquefaction of gases, he appears to have thoroughly understood the conditions upon which success could be obtained, as in his paper read before the Royal Society in 1845 he remarks:—

"The following gases showed no signs of liquefaction when cooled by a carbonic acid bath *in vacuo*:—

Hydrogen	at 27	atmospheres.
Oxygen	27	,,
Nitrogen	50	,,
Nitric oxide	50	,,

"The difference in the facility of leakage was one reason of the difference in the pressure employed. I found it impossible from this cause to raise the pressure of hydrogen higher than 27 atmos., by an apparatus that was quite tight enough to confine nitrogen to double that pressure.

"M. Cagniard de la Tour has shown that at a certain temperature a liquid under sufficient pressure becomes clear transparent vapour or gas, having the same bulk as the liquid. At this temperature, or one a little higher, it is not likely that any means of pressure, except perhaps one exceedingly great, would convert the gas into a liquid. Now the temperature of the carbonic acid bath *in vacuo*, viz., 166° below zero Fahr., *low as it is*, is probably *above* this point of temperature for hydrogen, and perhaps for nitrogen or oxygen."

In the same paper Faraday makes the further remark—"I am inclined to think that at about 90° Fahr. the Caigniard de la Tour state comes on with carbonic acid." Since Faraday wrote these words Dr. Andrews, in a series of classical experiments, introduced the word "Critical temperature or point," at which compression of a gas ceases to produce its liquefaction, and has moreover established experimentally the critical temperature of carbonic acid gas to be 31° C., or only 2° different from the conjecture of Faraday.

Physical Conditions Dependent upon Temperature.

Deg. F.	Deg. C.		Atmos. pressure.
+698	+370	Critical point of water	=195·5
+311	+155·4	,, ,, sulph. anhyd.	78·9
+285	+141	,, ,, chlorine ..	83·9
+266	+130	,, ,, ammonia ..	115
+212	+100·2	,, ,, sulphtd. hydr.	92
+ 98	+ 37	,, ,, acetylene ..	68
+ 95	+ 35·4	,, ,, nitrous oxide	75
+ 89	+ 31·9	,, ,, carbonic acid	77
+ 50	+ 10·1	,, ,, ethylene ..	51
+ 32	− 0	Nitrous oxide boils at 32 at. pres.	*Faraday.*
+ 32	− 0	Carbonic acid boils at 36 at. pres.	,,
+ 14	− 10	Sulphurous anhydride boils ..	,,
+ 15	− 10·5	,, ,, boils ..	*Bunsen.*
− 10	− 23	Methyl chloride boils	*Regnault.*
− 10	− 23	Carbonic acid boils at 19·38 atmos. pressure	*Faraday.*
− 20	− 29	Sulphurous anhydride boils in current dry air	*Pictet.*
− 20	− 29	Carbonic oxide and oxygen, air and nitrogen, compressed to 300 atmos. in glass tubes and suddenly expanded, show liquefaction	*Cailletet.*
− 26	− 32	Alcohol containing 52 per cent water freezes..	*Pictet.*
− 29	− 33·6	Chlorine boils	*Regnault.*
− 29	− 33·7	Ammonia boils..	*Bunsen.*
− 31	− 35	Commercial paraffin oil (sp. gr. 0·810) freezes	*Coleman.*
− 40	− 40	Nitrous oxide boils at 8·71 atmos. pressure	*Faraday.*
− 40	− 40	Carbonic acid boils at 11 atmos. pressure	,,
− 40	− 40	Ethylene boils at 13·5 atmos. pressure	,,
− 53	− 47	Freezing-point of Hollands gin and French brandy	*Coleman.*
− 60	− 51	Nitrous oxide boils at 5 atmos. pressure	*Faraday.*
− 60	− 51	Carbonic acid boils at 6·75 atmos. pressure	,,
− 60	− 51	Ethylene boils at 9 atmos. pres.	,,
− 62	− 52	American petroleum (sp. gr. 790) freezes	*Coleman.*
− 62	− 52	Freezing-point of extra strong whiskey and rum	,,
− 62	− 52	Alcohol containing 40 per cent water freezes..	,,
− 80	− 61·8	Sulphydric acid boils	*Regnault.*
− 80	− 62	Nitrous oxide boils at 3 atmos. pressure	*Faraday.*
− 80	− 62	Carbonic acid boils at 3·75 atmos. pressure	,,
− 80	− 62	Ethylene boils at 6·5 atmos. pressure	,,
− 99	− 73	Critical point of marsh-gas, pressure 56 atmos. ..	*Wroblewski.*
− 103	− 75	Liquefied ammonia freezes	
− 103	− 75	Alcohol containing 20 per cent water freezes..	*Coleman.*
− 108	− 78	Carbonic acid boils	*Faraday and Regnault.*
− 112	− 80	Solid sulphurous anhydride melts	*Mitchell.*
−123	− 86	Nitrous oxide boils	*Faraday.*
−123	− 86	Marsh-gas boils at 40 atmos. pressure	*Wroblewski.*
−128	− 87·9	Liquid nitrous oxide boils ..	*Regnault.*
−144	− 98	Marsh-gas boils at 25 atmos. pressure	*Wroblewski.*
−152	−102	Amyl alcohol an oily liquid ..	*Olzewski.*
−152	−102	Silicon fluoride a white mass..	,,
−152	−102	Arseniuretted hydrogen liquid	,,

Deg. F.	Deg. C.		
−152	−102	Hydrochloric acid boils	*Olzewski.*
−152	−102	Chlorine orange crystals	,,
−152	−102	Ethylene boils	*Wroblewski.*
−154	−103	,, ,,	*Olzewski.*
−166	−110	Solid carbonic acid and ether in vacuo	*Faraday.*
−171	−113	Critical point of oxygen, pressure 50 atmos.	*Wroblewski.*
−171	−113	Marsh-gas boils at 16 atmos. pressure	,,
−175	−115	Solid carbonic acid in vacuo, 25 m m. pressure	*Dewar.*
−175	−115	Hydrochloric acid gas solid	*Olzewski.*
−177	−116	Carbon disulphide solid.	
−180	−118	Arseniuretted hydrogen white crystals	*Olzewski.*
−193	−125	Nitrous oxide boils in vacuo	*Dewar.*
−200	−129	Ether solidifies	*Olzewski.*
−202	−130	Absolute alcohol solid	
−209	−134	Amyl alcohol solid	*Olzewski.*
−218	−139	Ethylene boils in vacuo	,,
−219	−139·5	Critical point of carbonic oxide, press. 35·5 atmos.	*Olzewski.*
−220	−140	Critical point of air, pressure 39·0 atmos.	,,
−220	−140	*Calculated* temp. of carbonic acid snow in vacuo (?)	*Pictet.*
−220	−140	Hydrogen compressed to 650 atmos. and pressure released produces momentary liquefaction and solidification	*Pictet.*
−220	−140	Oxygen compressed to 320 atm. and pressure released produces momentary liquefaction	*Pictet.*
−231	−146	Critical point of nitrogen, 35 atmos. pressure	*Olzewski.*
−238	−150	Ethylene boils in vacuo	,,
−238	−150	Carbonic oxide boils at 20 atm. pressure	,,
−242	−152	Atmospheric air boils at 20 atm. pressure	,,
−247	−155	Marsh-gas boils	*Wroblewski.*
−299	−184	Oxygen boils	,,
−312	−191·4	Air boils	*Olzewski.*
−312	−191·2	Air boils	*Wroblewski.*
−315	−193	Carbonic oxide boils	,,
−317	−194	Nitrogen boils	*Olzewski.*
−337	−205	Atmospheric air boils in vacuo.	,,
−348	−211	Carbonic oxide solidifies ,,	,,
−351	−213	Nitrogen boils in vacuo	,,
?	?	Hydrogen at 100 to 200 atmos. liquefies to colourless drops (in glass tubes 0·2 m.m. dia. surrounded by oxygen boiling in vacuo)	*Wroblewski and Olzewski.*
−355	−215	Calculated boiling-point of hydrogen	*E. J. Mills.*
−460	−273	Absolute zero	

N.B.—The critical points above freezing-point of water are quoted from Professor Dewar. *See* Chemical News, Jan. 16, 1885.

Now the critical point of oxygen gas has only been determined within the last year or two, Wroblewski making it −113° C., which Prof. Dewar has recently shown at the Royal Institution is attainable by the very same means as Faraday employed in his experiments on this gas, so that the liquefaction of oxygen has been delayed forty years by the simple accident of Faraday's compression pump not working so well with this gas as with other gases; and it was reserved for Faraday's successor, Professor Dewar, to exhibit the experiment for the first time to the members of the Royal Institution last year.

Within the last two or three years the critical temperature of almost all gases except that of hydrogen have been accurately determined, and it will be observed that in the case of seven well-known gases, viz., sulphurous acid, chlorine, ammonia, sulphuretted hydrogen, nitrous oxide, and ethylene, compression at ordinary atmospheric temperatures is sufficient to produce liquefaction; but in most cases the pressure required is very high, namely, from 50 to 100 atmospheres, or from 750 to 1500 lbs. per square inch.

M. Cailletet, together with M. Raoul Pictet, are generally credited with the discovery of the liquefaction of oxygen and hydrogen by experiments conducted independently of each other, but about the same date.

Cailletet's apparatus consists of a strong glass tube with the closed end pointing upwards, into which, by hydraulic pressure, a confined volume of gas was compressed, the tube being sometimes surrounded with a bath of some substance colder than the atmosphere; but M. Cailletet frequently trusted to the effect of the sudden expansion of the previously compressed gas for producing cold, so that he had to employ enormously higher pressures than he would have required for condensing the gas, supposing his tubes had been surrounded with something lower in temperature than the critical temperature of the particular gas he was experimenting with. Thus, he employed pressures of 300 atmospheres for liquefying oxygen, whereas, with a proper temperature, 60 atmospheres have been found to suffice. Moreover, this apparatus only liquefies the gas as a mist, or at the best in the form of drops. M. Raoul Pictet certainly succeeded in 1877 in producing liquid oxygen in somewhat larger quantities, visible for a few seconds, issuing out of a pipe when the cock was suddenly opened; but, apparently being unaware of the critical temperature of oxygen, he employed quite as high pressures as Cailletet.

The recent rapid advance in our knowledge of these liquefied gases has been owing chiefly to the employment of liquid ethylene as a means of cooling compressed oxygen, nitrogen, hydrogen, and other gases. Ethylene is what the older chemists called olefiant gas, and its boiling-point in the liquid state is −102° C., or −152° F.; *in vacuo* its boiling-point is as low as −150°, or −238° F. A tube or vessel surrounded with liquid ethylene, boiling *in vacuo*,—*i.e.*, by means of a vacuum pump,—becomes so cold as to liquefy atmospheric air, oxygen, nitrogen, &c., at very moderate pressures, so that to produce liquid ethylene in quantity is half way towards the attainment of these results.

It has been already shown that the critical point of ethylene is above the freezing-point of water, so that liquefying this gas is merely a question of compressing it into tubes surrounded by ice to, say, 750 lbs. per square inch. For this purpose a pump has been introduced by Cailletet, and described in the *Annales de Chemie*, tome xxix., 1883, which is said to be efficient for compression to high pressures, and worked by hand-labour at 30 to 37 revolutions per minute, will yield liquid nitrous oxide or ethylene, at the rate of 400 to 500 grms. per hour, equivalent, say, to the one-tenth part of a gallon.

As, however, any kind of pump working at such high pressure is difficult to manage and liable to mishaps, I venture to think there could be no better plan than pumping the gas by suitable pump into a coil of pipes externally cooled by a stream of cold air discharged from one of the machines devised by myself for technical purposes, and now used in various parts of the world for freezing animal carcases. Such machines are generally made to deliver continuous steams of air cooled to 50° or 80° below zero F., at which temperature it will be seen by the table ethylene liquefies at the reasonable pressure of about 8 atmospheres, or 120 lbs. per square inch, and nitrous oxide and carbonic acid at the reasonable pressure of about 4 atmospheres, or 60 lbs. per square inch. In my recent experiments in conjunction with Prof. McKendrick upon the influence of cold upon vital phenomena, our cold air machine delivered air at −86° C., or −123° F., which is sufficient to liquefy carbonic acid gas and nitrous oxide without any pressure, and ethylene at the small pressure of 50 lbs. per square inch.

Being, then, supplied with liquid carbonic acid, nitrous oxide, or ethylene in quantities, extremely low temperatures can be obtained, and it is by such means that the Russian observers, Wroblewski and Olzewski, have liquefied atmospheric air and other gases, such as nitrogen and carbonic oxide, in sufficient quantities to study their boiling-points and other physical characteristics. As, however, boiling any liquefied gas *in vacuo* is troublesome, and involves vacuum pump as well as compression pumps, liquid marsh-gas is a very convenient substance to use in liquefaction of atmospheric air and hydrogen, as its boiling-point in the *atmosphere* is lower than the boiling-point of ethylene *in vacuo*. Liquid marsh-gas could be easily prepared by compressing it to 50 atmospheres in tubes surrounded by cold air at —80° C. discharged from a cold air machine. Its boiling-point in the atmosphere is −155° C., and *in vacuo* is so low that it would probably liquefy oxygen, and without any compression.

If a cold air machine could be constructed for delivering the air cooled to below the critical temperature of oxygen, —and I think this is not impossible,—then this gas could be liquefied by compressing it to the extent of 100 atmospheres in a coil surrounded by such cold air. Such a process would be simple in principle, but the mechanical details more difficult than the stage method I have already described.

I must now direct attention to the general results of research as tabulated in the form prepared for this address, and first I must point out the extreme difficulty of measuring temperatures below which not only mercury becomes solid, but also such substances as alcohol, bisulphide of carbon, and ether, and which makes it necessary to use a perfect gas thermometer, or at any rate a gas so far removed from its point of liquefaction that it behaves as a perfect gas in expanding or contracting in the ratio of the absolute temperature.

Now it appears from the researches of the Russian chemists, Wroblewski and Olzewski, that at the temperature at which air becomes liquid hydrogen gas is unliquefied at 100 atmospheres, and therefore it is reliable for measuring down to that point, which is only about 70° above absolute zero, and it is understood that one of the Russian chemists has employed such a thermometer, whilst the other observer has used a thermopile, the published results corresponding fairly well; but it must not be hastily concluded that such electric measurements are so reliable as the employment of a good gas thermometer.

You have on the table a form of gas thermometer devised by myself, and which has been recently described to the Society in detail, also to the Society of Chemical Industry.

When liquefied gases are exposed freely to the atmosphere they evaporate at an enormous rate, which, however, is speedily checked and almost stopped by the large quantity of heat carried off by the rising vapour, and necessary to its assumption of the gaseous state, and which, robbing heat from the rest of the liquid, keeps down its temperature. Otherwise, there would be no dealing with these liquids when exposed to the air. It is otherwise, however, if the liquefied gases are corked or sealed up, as occurred with the samples of CO_2 and NO_3 shown you to-night. So that, in the case of liquefied air or oxygen, vessels able to withstand 200 atmos. pressure, or 3000 to the square inch, are necessary for storage, and with these gases the bottles containing them would require to be cooled to below the critical point, or the contents would be in the Cagniard de la Tour state.

From an engineering point of view, however, the storage of such liquids is quite easy, especially in bundles of iron pipes connected with a common outlet. Thus, the air of a large lecture-room, say 20,000 cubic feet capacity, when liquefied, would measure 150 or 200 gallons, and could be stored in 150 pipes of 10 feet long, 2 inches diameter, and ½ inch thickness of metal; indeed, by the formula commonly used by engineers, the thickness of an iron boiler of 12 inches diameter to contain the whole 200 gallons would require to be about 3 inches.

The critical point of hydrogen gas has not been determined, but one of our members, Prof. E. J. Mills, of the Andersonian University, calculates that from theoretical considerations it will be about −213°.

Pictet maintains that he has solidified it in the form of metallic particles, but this has not been confirmed, other observers having condensed it as a colourless liquid. It appears, therefore, that before long every known substance on the face of the earth will be capable of being solidified in the laboratory of the chemist by the mere abstraction of heat; and one cannot help being struck, in looking over the table I have already referred to, how, as temperature decreases, solidity gradually comes over the most active chemical agents, rendering them for all practical purposes as inert as so many pieces of stone.

Indeed, this tendency to inertness manifests itself before solidification occurs, for liquid carbonic acid, according to Gore, is unable to redden litmus, and is a comparatively inactive substance. We must not, however, conclude that all affinities will be dormant; for instance, may not oxygen and hydrogen, as we known them, be dissociated water, and may not the continued abstraction of heat from a mixture of these gases cause their union and the production of ice synthetically?

Against such a hypothesis, however, is the fact that liquefied atmospheric air has proved to be merely a mixture of nitrogen and oxygen, and not any form of oxide of nitrogen.

The facility with which alcohol freezes in all its forms is very interesting; and I may also mention that at about −86° C. the flesh of animals, such as mutton, becomes so exceedingly hard that it rings like porcelain when struck with an iron instrument,—indeed, crushes by the blow of a hammer into a fine powder, in which muscle, fat, and bone are intermingled; and what is still more singular, according to the experiments of myself and Prof. McKendrick, recently communicated to the Society, it appears that microbia alive in the flesh before the freezing operations can be detected still alive after thawing, even after exposure to −86° C., or −133° F., for one-hundred hours; thus pointing out to potential animal life in the solid state capable of being brought into activity by heat and moisture, just as a dry pea shoots into activity by the moisture of the soil and the heat of the sun.

Passing now from the consideration of low temperatures I have to direct your attention to certain phenomena which are invariably associated with high temperature, particularly the phenomena of artificial light. In these days of dynamos it appears, on the face of the subject, that light produced by electricity is essentially a mechanical operation; but such is not the case. *So long as coal or gas* is burned to drive the steam-engine which actuates the dynamos the process in its origin is chemical, and it will not be otherwise until the electrician confines himself to getting energy from the fall of water, or the motion of the tides or the wind.

As a rule he will probably have to look to chemical action for the origin of his power, in which case a galvanic battery or a dynamo may be defined as a piece of apparatus by which the heat produced by a chemical operation, instead of being developed at the dynamo or in the battery, is developed a long way off, the process and the resultant being connected by a wire.

Although the production of artificial light is not altogether a question of quantity of heat, but rather of the incandescence of solid particles at a high temperature, still there is no question that it is more economical to burn a substance in the immediate vicinity where heat is required than to have the chemical action at a distance which involves loss of energy in transit.

Lighting by electricity will always, however, have this great advantage, namely, that the apartments being lighted are not contaminated by the products of combustion, such as carbonic acid and sulphurous acid, which contaminate the air of apartments when gas is burnt.

The cost of electric lighting has been ably dealt with in a lecture delivered by Mr. Probert to the Society of Arts, September 12th, 1884. The statements therein made have been assumed to be correct by such authorities as the editors of *Engineering*, and are to this effect, viz., that 100 incandescent lamps of ¾ Ampère and 100 Volt. E.M.F. require 12½ H.P., or 56½ lbs. coal burned per hour under a boiler. Assuming that the light burn five hours daily, and taking into account interest and working expenses, the cost amounts to 8*s*. per day for the 100 lamps.

Mr. Probert then calculates the cost per day of a galvanic battery for effecting the same object, which he makes out to be about 40*s*. per day, involving the use of—

	£	*s.*	*d.*
85 lbs. zinc per day	0	13	3
7½ lbs. sulphuric acid per day ..	0	5	11
Depolarising chemicals..	1	1	8
	£2	0	10

Thus it will be seen that the cost of the electric current, by burning zinc in a battery instead of coal under a boiler, is five times as great.

Recently two Italians, Messrs. Bartoli and Papasogli, are said to have invented cells in which gas carbon or charcoal is oxidised by using a solution of sodium hypochlorite, and that the electromotive force of the cells varied from 0·4 to 0·5 of a Daniell cell, the oxidation products being mellic acid and other benzene carboxylic acids. The cost of the chemicals and the want of a ready market for the products of oxidation will, however, probably prevent such processes being commercially useful on the large scale.

It seems very singular to me that more attention has not been bestowed upon the utilisation of iron as the substance to be burned in a battery, seeing that the oxidation of iron, according to the researches of Andrews, develops about three-fourths as much heat as the oxidation of zinc. The exact figures are these: when iron is used for precipitating a solution of sulphate of copper 677 units as against 847 units developed when zinc is used.

Iron has been frequently used as the electro-negative element of a battery, especially when in the passive state, by contact with concentrated nitric acid. Probably the objection to its use as an electro-positive element has arisen from earlier experimenters finding local action uncontrollable, which in the case of zinc was easily obviated by amalgamation. I have recently made some experiments in this direction; in point of fact constructing a sulphate of copper cell, in which the copper is used in contact with sulphate of copper, as is customary in Daniell's cell, but the zinc is replaced with iron used in contact with protosulphate of iron; and find that three of such cells connected in series decompose water, so that the electromotive force is probably what theory indicates, about two-thirds that of a Daniell cell; moreover, such a construction of battery gives what the chemist dearly loves,—a chemical cycle easily worked, restoring the chemicals to their original state. The solution of sulphate of iron produced by the battery on evaporation and distillation yields sulphuric acid (or sulphurous acid) and peroxide of iron, the former ready to be combined again with the deposited copper, and the latter ready for the blast-furnace and reduction to metallic iron. I find that a form of cell similar to the Sir Wm. Thomson or Medinger cell, with some practical alterations in detail to suit best, and which, requiring no porous cells, can be made of any dimensions. A saturated solution of sulphate of copper contains one-fifth of its weight of the salt, and it floats upon a saturated solution of sulphate of iron, which contains only about one-third of its weight of the salt, so that if the sulphate of iron is drawn off as a saturated solution the copper plate requires to be at the top and the iron at the bottom of the cell.

If, however, saturated solution of sulphate of copper be put into a bell-jar, and metallic iron be placed in the upper part of the jar, the copper is replaced by iron, and we have a solution of sulphate of iron half saturated floating upon a solution of sulphate of copper fully saturated. The line of demarcation between the two solutions remains quite distinct for weeks, and very little diffusion occurs; consequently a very manageable cell is made by a horizontal copper plate being put at the bottom of a cell, containing a saturated solution of sulphate of copper, and one or more vertical iron plates being placed above in half-saturated solution of sulphate of iron. The solution of sulphate of iron is easily protected from the action of the atmosphere, and consequent decomposition, by means of a thin layer of mineral oil. If from time to time a solution of sulphate of copper is poured down a wide tube reaching to the copper plate, the iron solution being simultaneously drawn off from a higher level, a constant battery is constituted, which involves no cost in working beyond that incidental to the removal and recovery of the products, and which throws no product into the market the sale of which would be doubtful.

More plate surface, however, requires to be used with iron than with zinc, but iron is only one-fourth the price of zinc. I have found that three iron cells only give two-thirds of the electrolytic action given by two zinc cells, so that in practice probably the iron plates require to be double the size of the zinc plates for equal currents of electricity; but even then the arrangement should approximate in economy to the cost of lighting by the dynamo. It is obvious, also, that torrents of electricity could be evolved from the iron used in precipitating copper by the wet process of Henderson and others, if tanks be arranged in a similar way

Before passing from the subject I may mention that I have obtained powerful currents by dipping pans of iron and copper into a solution of common salt mixed with chloride of lime.

Although gas-lighting has been with us a settled institution, it does not follow that the only competitor it will have to contend with is the electric light; for, notwithstanding the predictions to the contrary, oil-wells are not becoming exhausted, but, on the contrary, vast tracts of country—especially in the South of Russia—abound in inflammable liquids, apparently inexhaustible.

All of these liquids when burnt in lamps smoke terribly, the evil being got over by the employment of long glass chimneys, which, however, only effect the object when the oil to be burnt is light in specific gravity. The experiment which I show you this evening proves that all such oils can be successfully burnt without smoke by means of circular wicks of asbestos, around the outside and into the centre of which a current of compressed air is made to flow upward.

It is easy to conceive that lamps on this principle can be constructed on any scale of magnitude, and that a town or community could be supplied with compressed air instead of gas, an arrangement which might suit Dr. B. W. Richardson in the future City of Utopia, though whether Sir F. Bramwell would be equally gratified I do not know, as he has recently told the public that gas-engines will in future supersede steam-engines.

It is a significant fact, however, that recently an Act of Parliament has been obtained for supplying Birmingham with compressed air, for working small engines instead of steam.

Connected with the subject of high temperatures, I will briefly refer to the death of Sidney Gilchrist Thomas, who has passed away at the early age of thirty-five, worn out with the toil of superintending the vast developments of the inventions of himself and his cousin, P. C. Gilchrist. These two young chemists in six years have revolutionised the iron manufacture of two districts in England, and of France, Germany, Austria, Russia, and Belgium. The basic process invented by them is a pure product of the chemical laboratory, and has accomplished the abstraction of phosphorus from Middlesbrough and other irons, a problem which has for years baffled the most strenuous efforts of Lowthian Bell, Siemens, and Bessemer.

I hope the few facts brought forward will show the importance of a thorough knowledge of chemistry to the other branches of science and to many of the arts. We all know Faraday as an electrician and physicist, but he was originally a chemist, and remained Professor of Chemistry to the end of his life. We all know James Watt as a great engineer, but he was also an excellent chemist, and divides with Cavendish the honour of the discovery of the chemical composition of water.

The address was illustrated by numerous experiments, and awarded a vote of thanks, moved by Dr. Henry Muirhead and seconded by Prof. Sir W. Thomson, who complimented Mr. Coleman on the great interest of his paper and his researches. He thought that Mr. Coleman's hydrogen thermometer might be relied upon to register temperatures as low as those hitherto observed by the Russian chemists, but the notion of a perfect gas thermometer was not admissible in face of the researches of Dr. Andrews on the continuity of matter. The absolute zero, indeed, is fixed from considerations independent of this, and might possibly be attained experimentally in future researches.

Sir W. Thomson also referred to the experiments on micro-organisms, and said it would be most interesting to see if Mr. Coleman's deduction—"that potential life can exist in a solid state"—is confirmed by experiments on vegetable seeds, with a view to ascertaining whether their vitality is destroyed by desiccation in a Sprengel vacuum or by long-continued drying at moderate temperatures.

A committee is now being organised to carry out this enquiry, and it is understood that Mr. Coleman and Dr. McKendrick are continuing their experiments.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

Note.—All degrees of temperature are Centigrade unless otherwise expressed.

Comptes Rendus Hebdomadaires des Séances, de l'Académie des Sciences. Vol. c., No. 12, March 23, 1885.

Remarks on M. Friedel's Criticisms with Reference to Chloral Hydrate.—L. Troost.—A reply to certain remarks in the *Bulletin de la Société Chimique*. The author argues that M. Friedel perpetuates a confusion between the sense of the word "dissociation" and that of the words "complete decomposition." M. Friedel supposes that the author's experiments have been made on a very small volume of vapour and those of Wurtz on larger volumes, which is just the inverse of what has actually taken place.

A Battery with Liquid Circulation.—J. Carpentier. —The battery in question works with a single liquid (solution of bichromate) and is peculiarly constant. The principle of the instrument is that of a syphon whose two unequal limbs pass into the same vessel containing the exciting liquid, the one terminating near the surface and the other passing nearly to the bottom. In the longer limb there are arranged the electrodes of a zinc and carbon element. When the syphon is set the liquid fills both limbs and is in equilibrium if it remains homogeneous. But as soon as we connect the two electrodes by a circuit a current takes it rise, the zinc is dissolved and augments the density of the liquid into which it plunges. The hydrostatic equilibrium is broken and an automatic circulation is established proportionate to the strength of the current. The liquid charged with zinc settles at the bottom of the reservoir, whilst fresh liquid remains separated from it by a definite plane surface and ascends to take the place of the liquid which gravitation has carried away.

The Preparation of Ammoniacal Gas.—M. Isambert. —In the preparation of gaseous ammonia by means of the anhydrous bases we have not to take account of the 425 cal. yielded by the union of the ammoniacal gas and the hydrochloric acid, and the reaction is reduced to the separation of the gases set free in consequence of a phenomenon of dissociation which borrows from neighbouring bodies the heat which it requires.

An Isomeric Monochloro-monobromo Camphor.— M. Cazeneuve.—The substance obtained is an isomer of that described in the author's last note. It is remarkable that in the numerous substitution-derivatives of camphor already formed two isomers constantly appear, the one with a higher melting-point, and in the form of large crystals, and the other of a soft consistence and an ill-defined crystalline form.

On Diethyl-amido-*α*-butyric Acid.—E. Duvillier.— This acid is a solid, crystalline body, extremely soluble in water, rather less soluble in absolute alcohol and very slightly soluble in ether. Ether precipitates this acid from its concentrated alcoholic solution as an oil. It is extremely deliquescent. The copper salt is the only one which the author has succeeded in obtaining pure and crystalline.

Moniteur Scientifique, Quesneville.
Vol. xv., April, 1885.

The Reactions produced in Lead Chambers.—G. Lunge and P. Naef.—A translation of a memoir already noticed.

German Patents for Colouring Matters.—A selection of abridged specifications published since the last week in January.

Patents taken out in France having Reference to the Chemical Arts.

Selection of Patents connected with the Chemical Arts.—It is not easy to see the line of distinction between the above two lists.

Industrial Society of Mulhouse.—Session of the Chemical Committee, Feb. 11, 1885.

The Secretary presented a note from M. Charles Zürcher, of Epinal, on the "Influence of Temperature and Aëration on the Development of Aniline Black." If after having printed an aniline black upon calico, it is exposed, while still moist, to a low temperature and to currents of air, the black does not develop. If the temperature is above + 13° or below 13°, if the cloth is slightly damp, and is protected from currents of air, the development of the black is still interfered with, though to a less degree. If, after printing, the cloth is kept about 25° the black is developed in a normal manner. It seems that under these conditions the salt of aniline evaporates.

M. Marius Moyret, of Lyon, sent in a note on a new method of preparing extract of indigo. It consists, essentially, in allowing the composition of indigo (so-called "sour-extract") to drain in moulds of porous plaster to free it from the brown, green, and other impurities which the sulphuric acid keeps in solution.

The Secretary presented three sealed papers by M. Scheurer-Kestner, one of which was opened in the session of January 28. The first, of October 3, 1877, relates to the utilisation of manganese chloride, the residue of the manufacture of chlorine. At the Thann works the air-pump in Weldon's process has been replaced by a Kœrting's apparatus, which in an installation of moderate size presents a decided economy.

The second paper, of October 4, 1877, treats of the use of Kœrting's apparatus for promoting the draught of the pyrites kilns, and at the same time supplying the chambers with the quantity of water necessary for the formation of sulphuric acid.

The third paper, of December 26, 1878, concerns an interesting decomposition of calcium sulphate by ferric oxide under the influence of heat. Fuming sulphuric acid is liberated.

M. Bourcart showed specimens of cotton-wool dyed according to a new process of his own invention.

M. Eug. Jacquet presented a note on a modification in the use of antimony oxalate, which consists in adding it to the colour itself after previous precipitation with ammonia. The colour composed of methylene blue, acetic acid, tannin, basic salt of antimony and ammonium oxalate, is fixed on, steaming in such a manner that the customary passage through tartar-emetic is no longer required.

The Leucomaines.—A. Gautier.—From the *Bulletin de la Soc. Chimique.*

A Contribution to the Chemistry of Nitro-glycerin.—Prof. M. Hay.—A lecture delivered at the University of Edinburgh.

Review of Foreign Researches in Chemistry.—A selection of extracts from the *Berichte der Deutsch. Chem. Gesellschaft.*

Journal de Pharmacie et de Chemie.
Vol. xi., No. 4, February 15, 1885.

Blistering Insects: the Seat of the Active Principle.—H. Beauregard.—The author enquires what are the vesicating species? what is the degree of their activity? and what is the seat of the active principle? The richest species is *Mylabris pustulata*, of India, which may contain as much as 12·50 grms. cantharidine per kilo. The active principle is concentrated in the blood and in the sexual organs.

On Vincetoxine.—Ch. Tanret.—This compound is due to a novel glucoside obtained from the root of *Asclepias vincetoxicum*. It does not reduce Barreswill's liquid until it has been heated with an acid. Its complete splitting-up is a tedious process. The glucose obtained is inactive, non-crystalline, and not fermentible. The other products are deeply coloured, and appear very complex.

Sulpho-carbol: its Antizymotic and Antiseptic Properties.—F. Vigier.—A continuation.

Second Memoir on Farinas.—M. Balland.—The conclusion of a memoir which has appeared in the *Comptes Rendus.*

Titration of Potassium Iodide.—C. Vial.—The author shows that the original process of Personne is more trustworthy than its modification by H. Carles.

On Thalline.—M. Boymund.—This compound, otherwise known as tetra-hydro-para-methyl-oxyquinoline, is characterised by taking an emerald-green colour with ferric chloride.

No. 5, March 1, 1885.

Formation of Ptomaines in Cholera.—A. Villiers.—The author has extracted from the remains of two cholera patients a well characterised alkaloid. He describes its reactions and the results of experiments made with it upon frogs and guinea-pigs. In the former the most prominent result was a slight and temporary decrease in the number of beats of the heart. In guinea-pigs death occurred in the course of four days.

Determination of Quinine in Cinchona Barks.—L. Masse.—The author substitutes ammonia for the lime generally employed. He pulverises and sifts the sample, and introduces into a 1 8th litre bottle 10 grms. of the powder, 15 c.c. of ammonia at sp. gr. 0·920, and 3 to 4 grms. of coarse small shot to assist in agitation. He closes with a good cork and shakes briskly. The mixture is allowed to stand for half an hour; 20 c.c. of chloroform are then added, the bottle stoppered, and shaken vigorously. For the ordinary stopper there is then substituted another cork traversed by a drawn-out tube, fitted within with a thread of tow. The bottle is inverted over a porcelain capsule, and the cholorform runs off perfectly clear from the tapering point of the tube. By alternately inclining and erecting the bottle all the chloroform is easily removed. This lixiviation is repeated five times, using 20 c.c. of chloroform each time; 100 c.c. of chloroform have always proved sufficient to exhaust 10 grms. of the bark. The chloroformic solution, on gentle evaporation, leaves a residue of alkaloids and of a little resin and colouring matter. It is treated with 10 c.c. of sulphuric acid at one-twentieth by volume, 20 c.c. of distilled water are added, and the mixture is heated on the water-bath for ten minutes. The alkaloids and a part of the resin dissolve. The latter is eliminated by adding to the hot solution, drop by drop, ammonia diluted with an equal volume of water. The liquid is then evaporated gently until a fine crystalline pellicle appears. Quinine sulphate crystallises out on cooling. It is put on a small plain double filter, 2 to 3 centimetres in diameter, washed with 2 c.c. of water poured on drop by drop, dried first over sulphuric acid and then at 100° in the stove, and weighed. The washings and the filtrate contain the other alkaloids, which may be determined, if needful, by de Vry's process.

The Determination of Iron by Margueritte's Process.—G. Linossier.—When determining iron by this method it is generally necessary to reduce the ferruginous compound in solution, as it is always, in part at least, in the ferric condition. For this purpose the author proposes a novel method. To the solution of ferric sulphate contained in a small flask he adds sodium carbonate until a slight precipitate appears, which is removed by the addition of a single drop of sulphuric acid. Into this liquid there is then passed, at from 50° to 80°, a current of sulphuretted hydrogen. The reduction is instantaneous when the solution is almost neutral. When it is complete (which may be exactly found by the action of potassium sulphocyanide upon a small drop), the liquid is heated to boiling for a few minutes, when the last trace of hydrogen sulphide escapes. To get rid of the last traces a few drops of a solution of mercuric chloride are poured into a flask. This compound, on contact with the hydrogen sulphide, is transformed into white chloro-sulphide. The heat is withdrawn, a few c.c. of sulphuric acid diluted with its own volume of water is added, the flask is stoppered, and allowed to cool. As an excess of precaution the cooling may be effected in a current of carbonic acid.

Basic Quinine Hydrochlorate.—A pharmaceutical paper without the name of the author.

No. 6, March 15, 1885.

The Determination of Organic Matters in Water.—A. Petit.—The author quotes the opinion of Daremberg that pure waters contain about 1 m.grm. of organic matter per litre, and potable waters about 3 m.grms., and adds that the best spring waters of the neighbourhood of Paris contain about 7 to 8 m.grms. The water from the spring of the Loiret, which supplies Orleans and which is well-known as being of excellent quality, contains 7·56 m.m. The waters of the Seine and the Marne above Paris contain 10 to 12 m.grms. per litre of organic matter. Is this increase of 2 to 4 m.grms. a sufficient reason for condemning them without inquiry? The author considers that chemistry supplies the best means of investigating waters.

Cornutinine and Ergotinine.—C. Tanret.—A discussion on the physiological action of the constituents of ergot.

Phosphoriferous Gypsum.—E. Reichardt.—In the neighbourhood of Jena there are beds of gypsum containing 2·94 per cent of phosphoric acid, of which 0·52 is soluble in water, 0·78 soluble in ammonium citrate, and the rest not attacked by this solvent.

MEETINGS FOR THE WEEK

Monday, 13th.—Medical, 8.30.
—— Society of Chemical Industry, 8. "Further Notes on the 'Radial' Photometer and the Proposed Standards of Light," by Mr. W. J. Dibdin.

Tuesday, 14th.—Institution of Civil Engineers, 8.
—— Royal Institution, 3. "Digestion and Nutrition," by Prof. Gamgee.
—— Society of Arts, 8. "British Interests in East Africa, particularly in the Kiliman'jaro District," by H. H. Johnston.
—— Royal Medical and Chirurgical, 8 30.
—— Photographic, 8.

Wednesday, 15th.—Royal, 4.30.
—— Geological, 8.
—— Society of Arts, 8. "On the Removal of House Refuse Independently of Sewage," by B. W. Richardson, M.D., M.A., F.R.S. "Proposal for the Abolition of Water Carriage in the Removal of Effete Organic Matter from Towns," by Thomas Hawkesley, M.D., M.R.C.P.

Thursday, 16th.—Royal Institution, 3. "Natural Forces and Energies," by Prof. Tyndall.
Chemical, 8.
—— Royal Society Club, 6.30.

Friday, 17th.—Royal Institution, 9. "Sunlight and the Earth's Atmosphere," by Prof. S. P. Langley.
—— Society of Arts, 8. "The Parsis and the Trade of Western India," by Jehangeer Dosabhoy Framjee.

Saturday, 18th.—Royal Institution, 3. "Fir-trees and their Allies," by Mr. W. Carruthers.

THE CHEMICAL NEWS.

Vol. LI. No. 1325.

ESTIMATION OF OIL IN CATTLE CAKE.

By SPENCER PICKERING, M.A.

Having had occasion to estimate the percentage of oil in some samples of linseed and cotton cake, a very simple and effective method of conducting the analysis suggested itself to me, and a description of it may be of some use to analytical chemists.

It consists in placing the sample together with about 50 c.c. of ether in a small well-stoppered bottle, tying the stopper down, and leaving the bottle in a vessel of boiling water for fifteen to thirty minutes. The solution of oil is decanted into a small weighed flask, the residue in the bottle washed with ether, and the washings added to the contents of the flask; ether may then be distilled off, and the residual oil dried at 100° C. A repetition of the process was found to give in no case more than 2 m.grms. of oil, thus appearing to be far more exhaustive than the methods usually employed,—which consist in either boiling the sample with ether in a flask fitted with an inverted condenser, or repeatedly drawing cold ether over the cake which is packed in a glass tube,—while at the same time it is more expeditious and less troublesome.

SOLDERING AND REPAIRING PLATINUM VESSELS IN THE LABORATORY.

By J. W. PRATT, F.C.S.

It frequently happens in the laboratory that platinum vessels, after long-continued use, begin to show signs of wear, and become perforated with minute pinholes. When they have reached this stage they are usually accounted of no further utility, and are disposed of as scrap; not that it is impossible to repair them—for with fine gold wire and an oxyhydrogen jet this is easily feasible,—but that the proper appliances and skill are not in possession of all. Irrespective of the manipulation of the hydrogen jet it is rather difficult without long practice to hold the end of the fine wire precisely over the aperture and to keep it in position. It occurred to me that if the gold in a finely-divided condition could be placed in very intimate contact with the platinum, that, judging from the fusibility of gold-platinum alloys, union could be effected at a lower temperature over the ordinary gas blowpipe. I tried the experiment, and found the supposition correct. The substance I used was auric chloride, $AuCl_3$, which, as is well known, splits up on heating, first into aurous chloride, and at a higher temperature gives off all its chlorine and leaves metallic gold. Operating on a perforated platinum basin, in the first instance, I placed a few milligrms. of the aurous chloride from a 15-grain tube precisely over the perforation, and then gently heated to about 200° C. till the salt melted and ran through the holes. A little further heating caused the reduced gold to solidify on each side of the basin. The blowpipe was now brought to bear on the bottom of the dish, right over the particular spots it was wished to solder, and in a few moments at a yellow-red heat (in daylight), the gold was seen to "run." On the vessel being immediately withdrawn a very neat soldering was evident. The operation was repeated several times till in a few minutes the dish had been rendered quite tight and serviceable.

Using the gold salt in this way the principal difficulty experienced in holding gold wire unflinchingly in the exact position vanishes, while only a comparatively low temperature and small amount of gold is necessary. Care must be taken to withdraw the platinum from the flame just at the moment the gold is seen to run, for if the heat be continued longer the gold alloys with a larger surface of platinum spreads, and leaves the aperture empty. As in the case of all gold-soldered vessels, the article cannot afterwards be safely exposed to a temperature higher than that at which the soldering was effected, and on this account it is advisable to use as small an amount of auric chloride as possible. When the perforations are of comparatively large size the repairing is not so easy, owing to the auric chloride, on fusing, refusing to fill them. I find, however, that if some spongy platinum be mixed with a few milligrms. of the gold salt, pressed into the perforation, and heat applied as directed, a very good soldering can be effected. It is well to hammer the surface of the platinum while hot, so as to secure perfect union and welding of the two surfaces. This may be done in a few minutes in such a manner as to render the repair indistinguishable. Strips of platinum may be joined together in much the same way as already described. A few crystals of auric chloride placed on each clean surface and gently heated till nearly black, then bound together and further heated for a few moments in the blowpipe flame. Rings and tubes can also be formed on a mandrel, and soldered in the same fashion, and the chemist thus enabled to build up small pieces of apparatus from sheet-platinum in the laboratory.

CONTRIBUTIONS TO THE CHEMISTRY OF MALTING.

Part II.

The Change produced by Germination in the Nitrogenous Matter of Barley.

By Dr. P. BEHREND.

The material changes accompanying germination are without doubt the most striking, and most important of all the metamorphoric processes occurring throughout the life of a plant. When the seed begins to vegetate all classes of organic compounds yield to its awakened activity; carbohydrates, fats, woody-fibre, and nitrogenous matter alike undergo vigorous decomposition, and are partially converted into new materials, and partially lost to the plant in gaseous form. From these facts it is evident, and in fact is well known, that researches on germinating seeds are very troublesome and difficult operations. Nevertheless, the subject has received considerable attention at the hands of scientists; and if the component parts of the plant are divided into nitrogenous and non-nitrogenous, it will be found that the changes in the latter class have been studied to a much larger extent than those incidental to the former class. This apparently arises from the circumstance that, as a rule, the nitrogenous matter of the plant undergoes decompositions which offer great difficulties to chemical investigation; but in spite of all this, this branch of the subject has received a due amount of attention. Copious reference is made to the work which has been done in this direction, and a glance at this literature shows at once that the majority of the investigations have been on the germination of seeds rich in nitrogen, such as lupin, bean, pea, pumpkin, and ricinus seeds, and that the chief conclusions are that during germination the albumenoids are converted, first, into a soluble modification, and then into amides. Of course it is quite justifiable to presume that seeds of other plants would behave in a similar manner under similar circumstances; but taking into consideration that the germination of barley is of more direct practical interest than that of any other cultivated plant, the author considers that, in proportion, the work done on the subject, more especially as regards the nitrogenous matter, is neither extensive nor exhaustive enough, and therefore the present experiments are undertaken to improve this branch of our knowledge. For instance, it is well known that during malting the amount of soluble albumenoids increase, and that this increase becomes greater as the malting process proceeds, but accurate quantitative data are wanting to support and confirm these facts, therefore the author now supplies these data as results of his experiments. The importance of such work is evident when it is remembered that the object of the malting process is the formation of diastase, and that the diastatic power of malt bears a direct proportion to the quantity of soluble albumenoids it contains. With regard to results obtained in some preliminary experiments with the samples of barley referred to in the first part of this communication, which, it may here be noted, were all quite normally developed and steeped to the same extent, the author observed that, owing to his methods not being perfected he does not attach too much weight to them, but nevertheless they are of much value, and are recorded below :—

Increase of Soluble Nitrogen through Germination.

Stage.	Per cent Dry Matter. Saxon Barley.	Bohemian Barley.	Hungarian Barley.
1. Fully steeped	0·272	0·217	0·185
2. After four days..	0·284	0·277	0·327
3. After seven days	0·579	0·528	0·695
4. After nine days	1·002	1·029	1·106
N p.c. in the dry matter of the original barley ..	1·838	1·490	2·290

The various stages of development of germination in the different samples of barley were kept as nearly equal as possible by regulating the thickness of the malt bed. From a practical point of view the progress of the malting was slow, and Stage 2 represents a malt "not quite ready"; Stage 3, "normal"; whilst Stage 4 is somewhat "overgrown." From the above numbers it will be seen that the kind of barley exerts considerable influence on the relative amount of nitrogen rendered soluble, and that there is an extraordinary rise between the 3rd and 4th stages; therefore, in a subsequent experiment several samples were taken during the later stages of germination. Continuing these investigations, the author first decided on his methods of analysis, and then proceeded to make the following determinations in the barley at each stage of the malting :—

1. Total nitrogen.
2. Nitrogen soluble in water.
3. Non-albumenoid nitrogen.

Difference between 1 and 3 gives total albumenoid nitrogen; whilst the difference between 2 and 3 is the soluble albumenoid nitrogen.

The first determination, and, in fact, all the nitrogen determinations, were made by Kjeldahl's method, wherein by heating the substance under examination with fuming sulphuric acid, and oxidising with permanganate, the nitrogen is converted into ammonia, which is distilled off by means of potassium hydroxide and collected in standard acid. Excess acid is titrated by means of potassium iodide, potassium iodate, and sodium hyposulphite, according to the equation—

$$5KI+KIO_3+3H_2SO_4=3I_2+3K_2SO_4+3H_2O.$$

Both processes are highly recommended for expediency, rapidity, and accuracy. Solids such as barley are treated directly with the sulphuric acid; liquids, on the other hand, are first evaporated to dryness in the flask, which is subsequently employed for the treatment with acid and the oxidation with permanganate. Trommsdorf's solution was employed as indicator in the titration with hyposulphite. To prepare for the third determination the barley extract is boiled for five to ten minutes with a solution of ferric acetate, by which the albumenoids are completely precipitated, and by adding to the boiling liquid as much sodium phosphate as will rest on the point of a knife, the precipitate subsides rapidly, and a filtrate is obtained almost as clear as water and perfectly free from albumenoids and iron. The solutions should, however, be tested for peptones and albumenoids (in absence of former, Millon's test is recommended by the author for the latter substances), and when both are absent, which was the case in all the author's experiments, determination 3 is proceeded with. If peptones are present in considerable quantities they are removed by phosphotungstic acid. The ferric acetate is prepared by agitating excess of carefully-prepared ferric hydroxide, in the form of a magma, with dilute acetic acid (1 : 3 water); the solution remains acid for a considerable time. The albumenoids are, however, completely precipitated by a slightly acid solution.

Series of Experiments, A, with Saxon Barley, large grains, (1000 air-dried weighing 47·48 grms.). 250 grms. of the original barley (Stage I.) were washed, and then steeped with two successive lots of 250 c.c. of the hard water mentioned in part 1, with the first lot 24, and with the second 12 hours; at the expiration of the 36 hours the barley was fully steeped (Stage II). It was then spread in a dish in layers about 2 c.m. deep, and covered with moistened filter-paper to prevent its becoming dry; carefully selected representative samples of 35 to 40 grms. were taken at the above and at the following stages :—

Stage III. After 22 hours; the rootsprouts had appeared.

Stage IV. After 62 hours; the root-sprouts were as long as the barley-grain, the grass-sprouts, ⅔ that length.

Stage V. After 86 hours; the root-sprouts 1½ and the grass-sprouts ¾ the length of the barley-grain.

Stage VI. After 134 hours; most of the root-sprouts were twice as long as the barley-grain, whilst some of the grass sprouts had commenced to shoot, and the majority of them were as long as the barley-grains; being in fact "slightly over-grown malt." For dry matter three lots each of 100 barley-grains were dried and weighed; for total nitrogen 25 of the dry grains were taken. The water extract was prepared by carefully crushing under water 15 grms. of the wet barley (10 grms. only of Stage I.), the volume was made up to 500 c.c., and the mass digested for 2 days with frequent agitation. 100 c.c. of the clear filtrate were evaporated, as described above, for the determination of the total nitrogen.

The extract free from albumenoids was prepared by boiling 15 (or 10) grms. with 250 c.c. water, crushing, boiling again, and then heating at the boiling-point with 50 c.c. ferric

Table of Results showing changes in the Nitrogenous Matter by the Germination of Barley (Saxony).

Stage.	State of germination.	100 Barley grains contain— Grms. Dry Matter.	M.grms. Nitrogen.	Per cent Nitrogen in the dry matter. Total.	Soluble in water.	Non-albumenoid.	Albumenoid. Soluble.	Albumenoid. Insoluble.	Albumenoid. Total.
I.	Original barley	4·025	74·0	1·838	0·332	0·178	0·154	1·506	1·660
II.	Fully steeped	3·871	70·1	1·811	0·212	0·167	0·045	1·599	1·644
III.	After 22 hours	3·814	69·2	1·814	0·217	0·159	0·056	1·599	1·655
IV.	After 62 hours	3·805	69·6	1·828	0·381	0·298	0·083	1·477	1·530
V.	After 86 hours	3·632	70·1	1·931	0·451	0·347	0·104	1·480	1·584
VI.	After 134 hours.. ..	3·430	69·8	2·035	1·045	0·489	0·556	0·990	1·546

acetate solution for about 10 minutes. The volume was made up to 500 c.c. and the non-albumenoid nitrogen determined in 100 c.c. of the filtrate.

Condition of the Nitrogen at Various Stages of Germination.

100 Parts of Nitrogen contained—

	Soluble in water.	Non-albumenoid.	Albumenoid.		
			Soluble.	Insoluble.	Total.
I.	18·1	9·7	8·4	81·9	90·3
II.	11·7	9·2	2·5	88·3	90·8
III.	12·0	8·8	3·2	88·0	91·2
IV.	20·8	16·3	3·5	80·2	83·7
V.	23·4	18·0	6·4	75·6	82·0
VI.	51·3	24·5	26·8	48·7	75·5

Series of Experiments, B, with Hungarian Barley, small grains (1000 air-dried = 39·56 grms.). Five kilos. were steeped with 5 litres of water, as in Experiments A, and spread out to germinate. Stages I., II., and III. (41 hours) were similar to those of A; the other stages were as follows:—(Lengths are as compared with a barley-grain).

Stage.	No. of hours.	Root-sprout.	Stock-sprout.	Condition of Malt.
IV.	89	About as long as one.	Half to two-thirds as long.	Not ready.
V.	113	1½ to twice as long.	Three-fourths as long.	Ripe.
VI.	137	Twice as long.	Almost quite as long.	Slightly overgrown.
VII.	185	About the same as VI.	Some begin to shoot.	Distinctly overgrown.
VIII.	209	The same as VII.	Many large shoots.	Much overgrown.

Samples of 150 to 200 grms. were taken of the various stages and the different determinations were made in proportionately large quantities.

Table of Results showing changes in the Nitrogenous Matter by the Germination of Hungarian Barley.

Stage.	100 Barley grains contain—		Per cent Nitrogen in the dry matter.					
	Grms. Dry Matter.	M.grms. Nitrogen.	Total.	Soluble. in water.	Non-albumenoid.	Albumenoid. Soluble.	Insoluble.	Total.
I.	3·344	76·6	2·29	0·30	0·12	0·18	1·99	2·17
II.	3·319	74·0	2·23	0·24	0·12	0·12	1·99	2·11
III.	3·153	74·4	2·36	0·40	0·18	0·22	1·96	2·18
IV.	3·145	74·5	2·37	0·79	0·43	0·36	1·58	1·94
V.	3·021	74·6	2·47	0·87	0·51	0·36	1·60	1·96
VI.	2·920	74·2	2·54	0·92	0·61	0·31	1·62	1·93
VII.	—	—	2·65	1·08	0·67	0·41	1·57	1·98
VIII.	—	—	2·68	1·11	0·74	0·37	1·57	1·94

Condition of the Nitrogen at Various Stages of Germination.

100 Parts of Nitrogen contained—

Stage.	Soluble in water.	Non-albumenoid.	Albumenoids.		
			Soluble.	Insoluble.	Total.
I.	13·1	5·0	8·1	86·9	95·0
II.	10·7	5·6	5·1	89·3	94·4
III.	17·0	7·4	9·6	83·0	92·6
IV.	33·5	18·2	15·3	76·5	81·8
V.	35·2	20·7	14·5	64·8	79·3
VI.	36·2	24·2	12·0	63·8	75·8
VII.	38·4	25·4	13·0	61·6	74·6
VIII.	41·6	27·5	14·1	58·4	72·5

Looking at these two series of results, noticing cursorily that the loss of dry matter by respiration was somewhat large for the length of period, which, however, is due to the warm weather, and that all losses between stages I and II. are due to the steeping-water referred to in Part I., we see the total nitrogen per barley-grain remains constant throughout germination, whereas, whilst the total soluble nitrogen and the non-albumenoid nitrogen show a steady increase, the total albumenoid and the insoluble albumenoid nitrogen decrease. The greatest diastic power of the malt, as indicated by the soluble albumenoids, calculated on the original dry matter, is about Stage VI. with the Saxon, and about V. in the Hungarian barley, thus supporting the well-known fact that prolonged germination is accompanied by loss of diastase. The other figures in the tables speak for themselves.

(To be continued

ACCIDENTAL EXPLOSIONS PRODUCED BY NON-EXPLOSIVE LIQUIDS.*

By SIR FREDERICK ABEL, C.B., D.C.L., F.R.S.

Ten years ago the lecturer discussed in some detail the various causes of the continually recurring casualties which are classed under the head of accidental explosions, and he then had occasion to compare the causes of coal-gas explosions, the occurrence of which is as deplorably frequent now as it was then, with those of accidents connected with the transport, storage, and use of volatile inflammable liquids which are receiving extensive application, chiefly as solvents and as illuminating agents.

Within the last few years he has had occasion to devote special attention to the investigation of instances of this class of accident, and to examine more particularly into the probable causes of frequent casualties connected with the employment of lamps in which the various products included under the general designations of petroleum and paraffin oil are burned. The latter branch of these inquiries, which is still in progress, has been conducted in association with Mr. Boverton Redwood, the talented Secretary and Chemist of the Petroleum Assciation, and with the valuable aid of Dr. W. Kellner, Assistant-Chemist of the War Department. Although it may be hoped that their continuation will lead to further data and conclusions of practical and public importance, it is thought that some account of facts already elicited may interest the members of the Royal Institution, and possess some general value.

Ever since liquids which, more or less rapidly, evolve inflammable vapour when freely exposed to air, or partially confined, have been in extensive use, casualties have occurred from time to time through the accidental or thoughtless ignition of the mixtures of vapour and air thus formed, whereby more or less violent and destructive explosions have been produced, often followed by the ignition of the exposed liquid which is the source of the explosive mixture, and by the consequent frequent development of disastrous conflagrations.

Many instances are on record of explosions, sufficiently violent to produce effects destructive or injurious to life and property, resulting from the application of flame to vessels which had contained either the more

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volatile coal-tar or petroleum products, or strong spirituous liquids, and which, though they had been entirely or nearly emptied of their contents, still contained, or retained by absorption within their body, some of the volatile liquid, this having, by evaporation into the air in the emptied receptacle, produced with it a more or less violently explosive mixture. Thus, a loud explosion occurred at the entrance of a lamp-maker's shop in Whitecross Street, which was found to have been caused by a boy throwing a piece of lighted paper into a cask standing under the gateway, which had contained benzoline; two boys were very seriously injured by the blast of flame which was projected from the barrel. A perfectly analogous accident was soon afterwards reported in the papers as having occurred at Sheffield, with serious injury to the author of the catastrophe and another boy; and a very similar case occurred at Exeter during the removal of some empty benzoline barrels, consequent upon a boy applying a lighted match to the hole of one of them. Again, at Spaxton in Somersetshire, a young man applied a light to the hole of a benzoline cask described as nearly empty which was standing in the road, when three young men were blown across the road, one of them being so seriously injured about the head that he died.

Explosions with similarly disastrous results have also been publicly recorded as having resulted from the application of a light to rum puncheons and whisky casks, even some time after they have been emptied of their contents, the evaporation of the alcohol absorbed by the wood having sufficed to convert the confined air into a violently explosive mixture.

The readiness or extent to which inflammable vapour is evolved from those products of the distillation of petroleum, or of shale or coal, which are used for illuminating purposes, differs of course considerably with the character of these liquids. Those which are classed as petroleum spirit (known as gasoline, benzine, benzoline, naphtha, japanners' spirit, &c.), and in regard to which there exist very special precautionary enactments, are, it need scarcely be said, of far more dangerous character than those classed as burning oils, which include the paraffin oils obtained from shale and the so-called flashing points of which range from 73° to above 140° F. The rapidity with which the vapours, evolved by the more volatile products on exposure to air, or by their leakage from casks or barrels, diffuse themselves through the air, producing with it more or less violent explosive mixtures, has been a fruitful source of disaster, sometimes of great magnitude. The lecturer had occasion to refer, in his discourse of 1875, to an accident at the Royal College of Chemistry of which he was a witness, in 1847, when the lamented Mr. C. B. Mansfield was engaged in the conversion of a quantity of benzol into nitrobenzol in a capacious glass vessel, which suddenly cracked, allowing the warm liquid hydrocarbon to escape and flow over a large surface. This occurred in an apartment 38 feet long, about 30 feet wide, and 10 feet high; there was a gas jet burning at the extremity of the room opposite to that where the heated liquid was spilled, and within a very brief space of time after the vessel broke, a sheet of flame flashed from the gas jet along the upper part of the room, to the spot where the fluid lay scattered.

The origin of a fire which occurred at some mineral oil stores at Exeter in 1882, affords another striking illustration of the great rapidity with which the vapour of petroleum spirit will diffuse itself through the air. The store which caught fire, and which contained both petroleum oil and spirit, or benzoline, was one of a range of arched caves upon the bank of a canal, being separated from it by a road-way about 50 feet wide. It was a standing rule at the stores that no light should be taken to any one containing benzoline. The benzoline casks were to be removed from this store, and the foreman, desirous of beginning the work early, and forgetful of the rule, went to the store shortly before daylight, carrying a lighted lantern, which he placed upon the ground at a distance of several feet from the doors. He then proceeded to open these. As he did so, he noticed a very powerful odour of benzoline, and, almost immediately, he saw a flash of flame proceed from the lantern to the store. He had just turned to escape, when an explosion occurred which blew the doors and the lantern across the canal; the benzoline in the store was at once inflamed, and flowed out into the road and upon the surface of the water, firing a small vessel which lay against the quay, and setting fire to the stores of benzoline contained in two neighbouring caves.

Many exemplifications might be cited of the danger arising from the accidental spilling or escape of petroleum spirit (or even of oils of very low flashing-point) in the ordinary course of dealing with these liquids, as in stores where there is but very imperfect ventilation, and in some part of which a flame exists, or is carelessly introduced; or, from the escape of spirit or its vapour from stores or receptacles to adjacent spaces where, its existence being unsuspected, the ignition of the resulting explosive mixture of vapour and air may be at any time brought about.

Without referring to accidents which have been due to flagrant carelessness in introducing a flame or striking a light in a store where petroleum vapour is likely to exist in the air, or where some form of spirit has been accidentally spilled, a few instances may be quoted which illustrate the magnitude of casualties liable to arise from the causes just referred to. Some years ago an explosion productive of much damage occurred in a sewer at Greenwich, and was clearly traced to the entrance into the sewer of some petroleum products (from a neighbouring patent gas factory); the vapours from these had diffused themselves through the air in the sewer to a considerable distance, forming with it an explosive mixture which must have been accidentally ignited at one of the sewer openings in the street above. Last spring a similar accident occurred at Newport in Monmouthshire, a quantity of benzoline having escaped into a sewer from a neighbouring store; the ignition of the resulting explosive mixture of vapour and air, with which a considerable length of the sewer became filled, tore up the roadway to some distance, several persons being thrown down. A terrific disaster of the same class was reported from San Francisco in November, 1879. During the driving of a tunnel in the San José Santa Cruz Railway, a vein of petroleum became exposed by the excavators, who were of course working with naked lights. Three violent explosions occurred in consequence, in rapid succession, resulting in the death of twenty-five Chinamen and in the injury of seventeen others and two white men.

Another accident which occurred near Coventry nearly five years ago, may be quoted in illustration of the unsuspected manner in which explosive gas-mixtures may exist in localities which to the superficial observer may appear to have no connection with a neighbouring locality where volatile liquids are liable to escape confinement.

A dealer in benzoline spirit kept his small store of that liquid (from 20 to 80 gallons) in an apartment of his house, upon the basement, the floor of the room being paved with red bricks. At a distance of about three feet from the store-room there was a well, the depth of which to the surface of the water was 20 feet. The well was closed in almost entirely with planks covered with earth. The water in the well being found foul, the owner had the latter uncovered, with a view to its being cleared out. The workman in charge of the operation, after having been engaged for three hours in pumping out a large quantity of the water, lowered a lighted candle into the well according to the usual practice to see whether he could descend with safety, when, while bending over the opening, he perceived a blue flame shooting upwards, and was violently thrown back and badly burnt, a woman who was watching him being similarly injured. The benzoline which had been spilled from time to time in small quantities in filling the cans of customers had readily passed through the porous brick upon which it fell, and gradually permeating the soil beneath had, in course of time, drained into the adjacent well. That this must occur under the circumstances described would have been self-evident to any one acquainted with the behaviour of these liquids and with the attendant circumstances. In localities where large quantities have for some time been stored in the usual casks or barrels, there is no difficulty in "striking oil" by sinking a well in the immediately adjacent ground, in consequence of the large amount of leakage of the spirit or oil which must unavoidably occur. Even in the absence of leakage from the openings of the barrels or from any accidental imperfection, considerable diffusion of the volatile liquid and consequent escape by evaporation through the wood itself, must occur in large petroleum stores especially if much exposed to the sun, and in the holds of ships where the temperature is generally more or less high. Even the precaution adopted of rinsing the barrels before use with a stiff solution of glue is not effectual in preventing the escape of the spirit from these causes, as the effect of alternations of temperature upon the barrels must tend to re-open any unsound places temporarily closed by the glue. Even at very extensive depots, where special arrangements were adopted to maintain the stores uniformly at a very moderate average temperature, the loss of petroleum spirit from leakage and evaporation was estimated, ten years ago, to amount to about 18 per cent of the total stored, while the average loss from the same causes upon petroleum oil was about 9 per cent. By the introduction from time to time of imporvements of the arrangements, the loss of spirit by leakage and evaporation has been very considerably reduced, amounting to less than 8 per cent in well-constructed stores, while at some petroleum stores, more especially in Germany, the loss of oil from leakage is now said not to exceed 1 per cent.

As in the case of the loss of coal-laden ships by explosions on the high seas, such loss has probably in many cases been due to the development of gas from the cargo, and to its diffusion into the air of parts of the ship more or less distant from the coal, producing an explosive atmoshere which might become ignited by the conveyance or existence of a light or fire, where its presence was not deemed dangerous; so also it is not improbable that the supposed loss by effects of weather, of missing petroleum-laden vessels, may have occasionally arisen from fire caused in the first instance by the diffusion of vapour, escaping from the cargo, through the air in contiguous parts of the ship, and the accidental ignition of the explosive atmosphere thus produced.

The possibility of such disasters has been demonstrated by the repeated occurrence of accidents of this class in ports or their vicinity. A very alarming instance of the kind occurred in 1871 on the Thames at Erith. Two brigantines had nearly completed the discharge of their cargoes of petroleum spirit ("naphtha"), when another vessel, the *Ruth*, from Nova Scotia, containing upwards of 2000 barrels of the same material, together with other inflammable cargo, anchored alongside them. This ship had encountered very severe weather, and it had been necessary to batten down the hatches; the cargo in the hold had consequently become enveloped in the vapour which had escaped from the casks. On the removal of the hatches, an explosive mixture was speedily produced by access of air, and, through some unexplained cause, became ignited shortly after the vessel anchored. A violent explosion followed, and the vessel was almost instantly in flames, the fire being rapidly communicated to the other two ships, which were with difficulty saved after sustaining considerable injury, while the *Ruth*, in which the fire raged uncontrollably, was after a time towed to a spot where she could burn herself out and sink, without damage to the other shipping. Three of the crew were seriously injured by the explosion, and the mate was blown to some distance into the water.

In June, 1873, a vessel (the *Maria Lee*), laden with 300 barrels of petroleum and other inflammable cargo, was destroyed by fire on the Thames near the Purfleet powder magazines, consequent upon the explosion in her of a mixture of petroleum vapour and air, and a similar accident occurred about the same time in Glasgow harbour. In the case of the *Maria Lee* it was clearly proved that the vapour resulting from leakage and evaporation of the spirit in the hold had diffused itself through the ship during the night, which was very hot, the hatches having been kept closed and covered with tarpaulin, in consequence of the occurrence of a thunderstorm. Upon the captain entering his cabin in the after-part of the ship early in the morning (and probably striking a light) a loud explosion took place, and flame was immediately seen issuing from the fore-part of the ship.

A very similar casualty to the foregoing occurred at Liverpool four years afterwards, in a small vessel laden with petroleum spirit, which proved not to have been at all adapted by internal construction for the safe carriage of such a freight. The cargo of 214 barrels of spirit had been stowed on board, and the hatches were put down and covered with tarpaulin. The cabin and forecastle of the smack were below deck, and were only separated by a thin partition from the hold. The loading had been completed between 6 and 7 o'clock in the evening, and at about 8 o'clock the captain went into the cabin and kindled a lamp. A man upon deck, who with another was injured by the explosion and fire, saw the light burning in the forecastle, and almost immediately afterwards the deck was lifted and the man was thrown some distance, while flame issued from the hold. The captain was terribly burned, and died shortly afterwards. In vessels which are constructed for the American petroleum trade, the cabins and forecastles are all upon deck, that part of the vessel which carries the freight, between decks, being as completely as possible separated from the other parts of the ship.

In some instances, ships laden with petroleum oil have become inflamed, in an unexplained manner, without the occurrence of any noticeable explosion, as was the case last year with a large vessel (the *Aurora*) in the port of Calcutta, after she had discharged more than half her cargo of 59,000 cases. The vessel burned for nine hours, the river becoming covered with burning oil as she gradually filled with water; the direction of the wind and the condition of the tide at the time of her sinking fortunately prevented the fire from reaching the shipping higher up the river.

There is no doubt that, while with cargoes of the more volatile petroleum products, classed as spirit, the greatest precautions are necessary to guard against the possible ignition of more or less explosive mixtures of vapour and air which will be formed in the stowage spaces of ships, and which may extend to other parts of the vessels unless very efficient ventilation be maintained, ships laden with the oils produced for use in ordinary petroleum- or paraffin-lamps, and which, yielding vapours at temperatures above the standard fixed as a guarantee of safety, incur comparatively very little risk of accident, provided simple precautions be observed. If, moreover, by some act of carelessness, or some accident not guarded against by the prescribed precautions, a part of such a cargo does become ignited, the prompt and, as far as practicable, complete exclusion of air from the seat of the fire, by the secure battening down of the hatches, will most probably save the ship from destruction. There are numerous records of vessels having discharged cargoes of petroleum oil, many barrels of which have been found greatly charred on the outside, occasionally even to such an extent that the receptacle has scarcely sufficient strength remaining to retain its contents. A remarkable illustration of the controllable nature of fire in a petroleum-laden ship was furnished by the ship *Joseph Fish*, laden with refined petroleum, lubricating oil, and turpentine, which, a fortnight after leaving New York (in September, 1879), was struck by lightning during a heavy squall, the hatches being closed at the time. Smoke at once issued from below, and the force-pumps were set to work directly to keep the fire down. The hatches were removed for examination as the fire appeared to gain ground, but were immediately replaced, and, after further pumping, as the fire appeared to increase, and an explosion was feared, the crew took to their boats, remaining near the ship. Eight hours afterwards they were picked up by a passing ship, which remained near the *Joseph Fish* until daylight. Her captain then returned on board, and as he found that the fire appeared to be out, the crew returned and the ship resumed her voyage, reaching the port of London without further incident, except that during the use of the pumps for removing the water, considerable quantities of petroleum and turpentine were pumped up with it from the hold. When the cargo was discharged, a large number of the barrels bore evidence of the great heat to which they had been exposed; several casks had gone to pieces and the staves of others were charred quite half-way through, although they still retained their contents.

The lecturer had occasion, ten years ago, to dwell upon the recklessness with which fearful risks were incurred, in some cases no doubt ignorantly, but in others scarcely without a knowledge on the part of those who were responsible, of the nature of the materials dealt with, by transporting volatile and highly inflammable liquids together with explosive substances in barges or other craft, and in doing so, moreover, without the adoption of even the most obvious precautions for guarding against access of fire to the contents of those vessels. The instance of the explosion in 1864 of the *Lottie Sleigh* at Liverpool, laden with 11½ tons of gunpowder, in consequence of the accidental spilling and ignition of some paraffin oil in the cabin of the ship, illustrated the danger incurred in permitting these materials to be together on board a vessel, and should have furnished some warning by the publicity it received; but the explosion ten years later, on the Regent's Park canal, of the barge *Tilbury*, revealed the continued prevalence of the same reckless disregard of all dictates of common prudence in dealing with the joint transport of explosives and volatile inflammable liquids.

The efficient laws and Government inspection to which all traffic in explosives has since then been subject, has rendered the recurrence of that identical kind of catastrophe almost out of the question, but an illustration has not been wanting quite recently of the fact that, but for the respect commanded by the rigour of the law, barges passing through towns would probably still carry freights composed of petroleum spirit and powder, or other explosives, being at the same time provided with a stove, lamp, and matches for the convenient production of explosions. In August, 1883, an explosion occurred on the canal at Bath, in a barge which sank immediately, the master being slightly injured; the freight of the vessel consisted of petroleum, benzoline, and lucifer-matches.

The last four years have furnished several very remarkable illustrations of great injuries inflicted on ships by explosions, the origin of which was traced to the existence on board of only small quantities of some preparation containing petroleum spirit, or benzoline, with the nature of which the men who had charge of them were not properly acquainted. These materials had consequently been so dealt with as to become the means of filling more or less confined spaces in the ships with an explosive atmosphere which, when some portion of it reached a flame, was fired throughout, with violently destructive effects.

The first authenticated case of an accident due to this cause occurred in June, 1880, on board the Pacific Steam Navigation Company's steamer *Coquimbo*, shortly after her arrival in the morning at Valparaiso from Coquimbo. A violent explosion took place, without any warning or apparent cause, in the fore-peak of the vessel, blowing out several plates of the bow and doing other structural damage, besides killing the ship's carpenter; the explosion could only be accounted for by the circumstance that a small quantity of a benzoline preparation used for painting purposes (probably as "driers") was stored in the fore-peak, and that a mixture of the vapour from this with the air had become ignited. The sufferer was the only person who could have thrown light upon the precise cause of the accident, but there was no other material whatever in that part of the ship to which the explosion could have been in any way ascribed.

In May, 1881, an explosion of a trifling character occurred on board H.M.S. *Cockatrice* in Sheerness Dockyard, in consequence of a man going into the store-room with a naked light and holding it close to a small can which was uncorked at the time, and which contained a preparation recently introduced into the naval service as a "driers" for use with paint, under the name of *Xerotine Siccative*. This preparation, which was of foreign origin, appears to have been adopted for use in the naval service and to have been issued to H.M. ships generally without any knowledge of its composition, and without attention being directed to the fact that it consisted very largely of the most volatile petroleum spirit, which would evaporate freely if the liquid were exposed to air at ordinary temperatures, and the escape of which from a can, jar, or cask, placed in some confined and non-ventilated space, must speedily diffuse itself through the air, and render the latter more or less violently explosive.

When attention was directed to the highly inflammable character of this xerotine siccative by the slight accident referred to, official instructions were issued by the Admiralty, in June, 1881, to ships and dockyards that the preparation should be stored and treated with the same precautions as turpentine and other highly inflammable liquids or preparations.

The following November, however, telegraphic news was received of a very serious explosion on board H.M.S. *Triumph*, then stationed at Coquimbo, due to the xerotine siccative. The explosion took place early in the evening of the 23rd November, and originated in one of the paint-rooms of the ship; the painter and a marine who was assisting him were in the upper paint-room at the time; the former received severe internal injuries and afterwards died, the latter was killed at once. One man standing at the open door of the sick-bay furthest from the explosion was instantaneously killed, others in close proximity receiving only superficial injuries. Altogether there were two killed, two dangerously wounded—of whom one died—and six injured, by the explosion.

The results of the official inquiry held at Callao led to the conclusion that the explosion was caused by the ignition of an explosive gas-mixture produced by xerotine siccative which had leaked from a tin kept in a compartment under the paint-room and quite at the bottom of the ship, usually termed the "glory hole"; that locality having been considered by the captain of the ship as the safest place in which to keep this material, to the dangerous nature of which his attention had been recently called by the receipt of the Admiralty Circular. It transpired that the painter had sent his assistant down to this compartment from the paint-room to fetch some paint. The man, who had a hand-lantern with him, while unscrewing the hatch, which had not been opened for three days, made the remark that there was a horrible smell; the chief painter told him to return, as he thought the smell was due to foul air, and immediately afterwards the explosion occurred.

The tin can, which had contained six gallons of the liquid, was found, after the accident, to have received injury as though some heavy body had fallen or been placed upon it; this appeared to have been done before the explosion, and there is no doubt that the liquid had leaked out of the can, and had evaporated into the air in the compartment beneath the paint-room, and probably also to some extent in the adjoining spaces. The damage done was very considerable. An iron ladder leading from one paint-room to the other was so twisted up as to have lost all semblance of originality, the wooden bulkhead separating the upper paint-room and sick-bay was completely blown away, the framing of the ship's side in the sick-bay was blown inwards and broken, the furniture in the latter was completely shattered, and the bedding and clothes of the men near the explosion were much burned. The inquiries which followed upon this deplorable accident showed that, while due precautions were taken to store the supplies of mineral oil used for burning purposes, of turpentine and of spirit, which were sent to different naval stations for supply to the fleet, in special parts of the ships or on deck, this highly inflammable liquid, which was far more dangerous than other stores of this class, had been sent in freight-ships as common cargo, being stored in the hold without any precautions. A stone jar which was advised as containing a supply had arrived at its destination in the Pacific quite empty, the contents having leaked out and evaporated on the passage out, so that the vessel carrying it had been unsuspectedly exposed to very great danger.

(To be continued.)

A CATALOGUE OF CHEMICAL PERIODICALS.*

By H. CARRINGTON BOLTON, Ph.D.,
Professor of Chemistry in Trinity College, Hartford, Conn.

(Continued from p. 172).

Explanation of Signs.

\+ Following a date signifies current at the date in question.
|| Following a date signifies publication discontinued.

6. Almanacco di Chimica Agricola. Dal A. Selmi. 6 vols., 16mo. Milano, 1873-'78 [+ ?].

7. Almanach de la Chimie, par H. du M. 8 vols., 18mo. Rouen et Paris, 1854-'61.

8. Almanach für Scheidekünstler und Apotheker. Herausgegeben von J. F. A. Göttling. 23 vols., 8vo. Weimar, 1780-1802.

Continued under the Title;

[a] Taschenbuch für Scheidekünstler und Apotheker, herausgegeben von Ch. Fr. Bucholz. 17 vols. (xxiv.-xl.), 8vo. Weimar, 1803-'19.

Continued under the Title:

[b] Trommsdorff's Taschenbuch für Chemiker und Pharmaceuten. 10 vols (xli.-l.), 8vo. Jena, 1820-'29. ||

Register, 1780-1803. 1 vol., 8vo.
Edited from 1780-1802, *by* J. F. A. Göttling; 1803-'15, C. F. Bucholz; 1806-'17, C. F. Bucholz *with* Wilh. Meissner; 1818, C. F. Bucholz *with* Rud. Brandes; 1819, Rud. Brandes; 1820-29, J. B. Trommsdorff.

Almström, P. O.
See Tekno-kemisk Journal.

American Chemical Review.
See Chemical Review and Journal [*a*].

American Chemical Society.
See Proceedings of the.

9. American Chemical Journal. Edited, with the aid of chemists at home and abroad, by Ira Remsen. 6 vols., 8vo. Baltimore, Md., 1879-'84.+

10. American (The) Chemist. A monthly journal of theoretical, analytical, and technical chemistry. Edited by Chas. F. Chandler and W. H. Chandler. 6 vols. and 6 nos., 4to. New York, 1870-'77. ||

11. American (The) Laboratory. A bi-monthly journal of the progress of chemistry, pharmacy, medicine, recreative science, and the useful arts. 4to. Boston, 1875.

12. Analyst (The), including the proceedings of the "Society of Public Analysts." A monthly journal of analytical chemistry. Edited [in 1882] by G. W. Wigner and J. Muter. 9 vols., 8vo. London, 1876-'84.

Annalen der Chemie und Pharmacie.
See Annalen der Pharmacie.

Annalen der Chemischen Literatur.
See Bibliothek der neuesten physisch-chemischen - - Literatur.

13. Annalen der Pharmacie. Eine Vereinigung des Archives des Apotheker-Vereins im nördlichen Teutschland, B. xl.; und des Magazins für Pharmacie und Experimentalkritik, B. xxxvii. Herausgegeben von Rudolph Brandes, Ph. Lorenz Geiger, und Justus Liebig. 10 vols., 8vo. Lemgo und Heidelberg, 1832-'34.

Continued (*from vol.* xi., 1834) *under the Title:*

[a] Annalen der Pharmacie. Vereinigte Zeitschrift des Neuen Journals der Pharmacie für Aerzte, Apotheker und Chemiker, Band xxviiii.; des Archivs des Apothekervereins im nördlichen Deutschland, Band xlix.; und des Magazins für Pharmacie und Experimentalkritik, Band xlvi. Von Johann Bartholomä Trommsdorff, Rudolph Brandes, Philipp Lorenz Geiger, und Justus Liebig. 22 vols. (xi.-xxxii.), 8vo. Heidelberg, 1834-'39.

Vols. xvii.-xxii., *edited by* J. B. Trommsdorff, Justus Liebig, *and* Emanuel Merck. Vols. xxiii.-xxvi., *edited by* Justus Liebig, Emanuel Merck, *and* Friedrich Mohr. Vols. xxvii.-xxxii., herausgegeben unter Mitwirkung der HH. Dumas in Paris und Graham in London, von Friedrich Wöhler und Justus Liebig.

Continued under the title;

[b] Annalen der Chemie und Pharmacie. Unter Mitwirkung der HH. Dumas in Paris und Graham in London, herausgegeben von Friedrich Wöhler und Justus Liebig. 136 vols. (xxxiii.-clxviii.), 8vo. Heidelberg, 1840-'73.

From vol. xli. *the names* Dumas and Graham *are dropped. From* vol. lxxvii. (1851), *edited by* Friedrich Wöhler, Justus Liebig, *and* Hermann Kopp; neue Reihe Band i. *From* vol. clix. (1871), *edited by the same, together with* E. Erlenmeyer *and* J. Volhard.

Continued under the title;

[c] Justus Liebig's Annalen der Chemie und Pharmacie. Herausgegeben von Friedrich Wöhler, Hermann Kopp, Emil Erlenmeyer, Jacob Volhard [*later, by the same, with* A. W. Hofmann, Aug. Kekulé]. 58 vols. (clxix.-ccxxvi.), 8vo. Leipzig und Heidelberg, 1873-'84.+

[d] Supplement-Band i., 1861; ii., 1862-'63; iii., 1864-'65; iv., 1865-'66; v., 1867; vi., 1868; vii., 1870; viii., 1872.

Autoren- und Sach-Register zu den Bänden i.-c. (Jahrgang, 1832-'56) der Annalen der Chemie und Pharmacie. Bearbeitet von G. C. Wittstein. 8vo. Leipzig und Heidelberg, 1861.

Autoren- und Sach-Register zu den Bänden ci.-cxvi. (Jahrgang, 1857-'60) der Annalen der Chemie und Pharmacie. Bearbeitet von G. C. Wittstein. 1 vol., 8vo. Leipzig und Heidelberg, 1861.

Autoren- and Sach-Register zu den Bänden cxvii.-clxiv. und den Supplementbänden i.-viii. (1861-'72), der Annalen der Chemie und Pharmacie. Bearbeitet von Friedrich

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* Advance-proofs from the *Annals of the New York Academy of Sciences.*

Carl. 1 vol., 8vo. Leipzig und Heidelberg, 1874.

General-Register zu den Bänden CLXV.-CCXX. (1873-'83), von Leibig's Annalen der Chemie (früher Annalen der Chemie und Pharmacie), bearbeitet von Friedrich Carl. 1 vol., 8vo. Leipzig, 1885.

Cf. Magazin für Pharmacie.

ANNALEN DER PHYSIK UND CHEMIE. Poggendorff. *See* Journal der Physik. Gren.

(To be continued).

PROCEEDINGS OF SOCIETIES.

CHEMICAL SOCIETY.

Annual General Meeting, Thursday, March 30, 1885.

Dr. W. H. PERKIN, F.R.S., President, in the Chair.

THE President read an address, of which the following is a brief abstract:—

The number of Fellows is now 1360, being an increase of 34 since March 31st, 1884. The losses have been exceptionally heavy, 4 Honorary Foreign Members, Victor Dessaignes, Adolph Wurtz, Jean Baptiste Dumas, and Hermann Kolbe, having died during the year, besides 18 Fellows: G. D. Atkinson, Adrian Blaikie, James Forrest, Robert Harvey, J. W. Hudson, F. M. Jennings, Robert Jones, M. J. Lansdell, James Napier, H. B. Pritchard, T. K. Rogers, Juwansnigji Jarwatsnigje, R. Angus Smith, J. L. Shuter, Sidney Gilchrist Thomas, A. Voelcker, Henry Watts, and G. W. Wigner. 32 Fellows have either withdrawn or have been struck off the list as being in arrear of their subscriptions.

After speaking of the great loss which the Society had experienced in Mr. Watts, the President referred to the appointment of Mr. C. E. Groves, F.R.S., as Editor; of Mr. A. J. Greenaway, as Sub-Editor; and Dr. L. T. Thorne, as Librarian.

Very considerable additions have been made to the Library, and the thanks of the Society are due to Fellows who have responded to the appeal for copies of old editions to complete series of standard works. The Library is increasing so fast that additional accomodation will soon be a necessity. It is expected that the complete subject catalogue will be issued before long.

Reference was next made to the Society's new publication, the "Abstracts of Proceedings," and to the Reception held by the President and council; a second Reception will be held later in the Session.

The chief chemical work of the year was then passed in review.

Last year, the President referred in his address to the comparatively small amount of original work which was being prosecuted in this country, notwithstanding the increased number of laboratories, and the greater facilities which were offered for the encouragement of research. The number of papers brought before the Society during the year is 67, but although the number has not increased, if the papers themselves be examined, it will be found, the President thinks, that the amount of work done is somewhat larger, though certainly not so large as it should be. It is to be hoped that the spirit of research will be stimulated in the laboratories of the kingdom, and that men may be turned out who are not only more or less qualified analysts, but thorough chemists. "Let us not," said the President, "be content with looking back with pride to what our ancestors have done, but let us follow their example."

It was then moved by Dr. GLADSTONE, and seconded by Sir F. A. ABEL, that the best thanks of the meeting be given to the President for his address, and that he be requested to allow it to be printed. This resolution was unanimously accepted, and the President returned his thanks.

Dr. RUSSELL, the Treasurer, then read his report:—The income of the Society for the year was about £3569, the expenditure £3,283, leaving a balance of only £286; about £2198 had been expended on account of the Journal, and about £440 on account of the Library.

Mr. MOND proposed, and Mr. MAKINS seconded, a vote of thanks to the Treasurer, to which Dr. RUSSELL replied.

Mr. FRISWELL proposed, and Mr. G. S. JOHNSON seconded, a vote of thanks to the Auditors, Mr. Makins, Mr. R. H. Davies, and Dr. P. F. Frankland. Mr. MAKINS replied.

A vote of thanks to the Officers and Council was then proposed by Mr. WARINGTON, seconded by Mr. RILEY, and replied to by Dr. ARMSTRONG.

Mr. TYRER proposed, and Dr. JAPP seconded, a vote of thanks to the Editor, Sub-Editor, Abstractors, and Librarian. Mr. GREENAWAY replied.

Dr. Plympton and Mr. E. W. Voelcker were appointed scrutineers, and a Ballot having been held, the following were declared elected as Officers and Council for the ensuing year:—

President: Dr. Hugo Hüller.

Vice-Presidents who have filled the office of President: Sir F. Abel, Dr. Warren De la Rne, Prof. Frankland, Dr. J. H. Gilbert, Dr. J. H. Gladstone, Dr. A. W. Hofmann, Prof. Odling, Dr. W. H. Perkin, Sir Lyon Playfair, Sir Henry Roscoe, and Prof. A. W. Williamson.

Vice-Presidents: Mr. W. Crookes, Prof. G. D. Liveing, Dr. Schunck, Prof. T. E. Thorpe, Dr. Tilden, and Mr Walter Weldon.

Secretaries: Dr. H. E. Armstrong and Mr. John M. Thomson.

Foreign Secretary: Dr. F. R. Japp.

Treasurer: Dr. W. J. Russell.

Ordinary Members of Council: Dr. E. Atkinson, Mr. H. T. Brown, Dr. Carnelley, Mr. Carteighe, Dr. F. Clowes, Mr. A. E. Fletcher, Prof. G. C. Foster, Mr. Friswell, Mr. Meldola, Dr. Messel, Mr. Ludwig Mond, and Mr. C. O'Sullivan.

April 2nd, 1885.

Dr. H. MÜLLER, F.R.S., President, in the Chair.

Certificates were read for the firse time in favour of Messrs. Edward Grindle Hogg, Sandringham Gardens, Ealing; F. R. Mallet, Calcutta; John A. Tate, 33, Selborne Street, Liverpool.

The following papers were read:—

24 "*On the Formation of Hyponitrites from Nitric Oxide.*" By Prof. DIVERS and T. HAGA.

An alkaline solution of potassium stannite slowly absorbs nitric oxide, and when treated with silver nitrate gives a precipitate, from which, by treatment with nitric acid and ammonia, silver hyponitrite can be obtained in small quantity. Potassium stannite in alkaline solution has no action on nitrites and nitrates. Ferrous hydroxide treated with strong solution of alkali becomes dense, pulverulent, and pale grey, and in taking up oxygen does not form any black hydroxide as an intermediate product. Ferrous hydroxide mixed with potassium hydroxide solution, converts nitric oxide, and also nitrites, into ammonia. It has no action upon nitrates in presence of much potassium hydroxide.

25. "*On the Existence of Barium and Lead Nitroso-sulphates.*" By Prof. E. DIVERS and T. HAGA.

Barium nitrososulphate can be precipitated from an alkali nitrososulphate by barium hydroxide if concentrated solutions are used. It is soluble in water, and decomposed by acids. Lead nitrososulphate mixed with hydroxide is precipitated from a nitrososulphate solution by adding basic acetate of lead to it.

Before this, attempts to form other nitrososulphates than those of the alkalies have proved unsuccessful.

36. "*Notes on Fractional Distillation in a Current of Steam.*" By Dr. M. G. Lazarus.

Difficulty having been experienced in the separation of iodothiotolen and iodothioxen from toluene and xylene respectively, owing to the two former compounds being almost totally decomposed on distillation even under reduced pressure, experiments were made to ascertain whether a separation could be effected by distilling in a current of steam. Mixtures of benzene and toluene, benzene and nitrobenzene, toluene and nitrobenzene, toluene and xylene, benzene and carbon bisulphide, turpentine and nitrobenzene, and aniline and nitrobenzene were employed. A perfect separation could not in every case be effected, but the results are so far satisfactory as to render the method of practical use, and it was found that pure iodothiotolen and iodothioxen could be obtained by it.

Discussion.

Dr. Perkin remarked that if he understood the author's remarks correctly, the methods employed would yield the best results with mixtures of liquids differing considerably in their densities, and stated that this had been his own experience.

The President stated that his experience had been similar to that found by Dr. Perkin.

27. "*Derivatives of Taurine.*" Part I. By J. W. James.

The author has investigated the action of mono-, di-, and tri-amines on the corresponding salts of β-chlorethanesulphonic acid, and in this way prepared mono-, di-, and tri-substituted derivatives of taurine (β-amidoethylsulphonic acid).

The method consists in heating the substituted ammonium salt of the acid with the calculated quantity of amine in a closed tube for ten hours at 160°, when the taurine-derivative is formed, mixed with the hydrochloride of the base. For mono- and di-derivatives the following method was employed in separating the hydrochloride. The contents of the tube were treated with an excess of barium hydrate, and steam was passed in until all the amine had distilled off. The barium was then removed by pouring the boiling solution into the calculated quantity of boiling dilute sulphuric acid; after filtering from $BaSO_4$, the solution was evaporated, leaving the substituted taurine.

Trimethyltaurine being easily decomposed by dilute solution of alkalies, barium hydrate could not be employed; it was, however, readily obtained in a state of purity by boiling the mixture of trimethyltaurine and trimethylammonium chloride with strong alcohol, which dissolved only the chloride.

In this manner *ethl-*, *allyl-*, *phenyl-*, *dimethyl-*, *diethyl-*, *methyl-phenyl-*, and *trimethyl-taurines* have been prepared. They are beautifully crystalline substances, all of which dissolve in water and alcohol, with the exception of trimethyltaurine, which is insoluble in the latter liquid.

The di-substituted taurines are of special interest, as corresponding compounds in the carboxyl series are not known. The mono- and di-taurines form no compounds with acids or platinum chloride, and in this respect are sharply distinguished from the corresponding derivatives of amido-acetic and propionic acids. The mono- and di-derivatives have an acid reaction (J. Lang, *Bull. Soc. Chim.* [2], xxv., 80.) Trimethyltaurine is perfectly neutral to litmus.

The action of cyanamide has also been studied, and phenyltaurocyamine and dimethyltaurocyamine have been prepared. They are crystalline substances, soluble in water.

Discussion.

The President remarked that as we have in taurin, or amidethylsulphonic acid, the basic and acid properties so nearly balanced, it might have been expected that by a farther introduction of alcohol radicles the alkaline character would become more pronounced. According to the results of the author, however, this does not appear to be the case.

28. "*On the Preparation of Ethylene Chlorothiocyanate and β-Chlorethanesulphonic Acid.*" By J. W. James.

It is found that a much better yield of the thiocyanate is obtained by distilling the product of the action of potassium thiocyanate on ethylene chlorobromide under reduced pressure.

Pure chlorethanesulphonic acid can only be prepared by treating the barium salt with sulphuric acid; even when very dilute solutions of the lead salt are treated with sulphuretted hydrogen, some lead always remains dissolved.

29. "*The Orthovanadates of Sodium and their Analogues.*" By Harry Baker, Berkeley Fellow, Owens College.

Though vanadium belongs to the phosphorus, arsenic, niobium, and tantalum-group of elements, the number of points of resemblance between their compounds is not very great; and indeed Mendelejeff remarks that the analogues of vanadium are titanium and chromium, and niobium and tantalum, to which latter it shows greater resemblance than to phosphorus; and Rammelsberg after examining numerous vanadates, concludes that they cannot be compared with the phosphates. In a previous paper to this Society I described certain unsuccessful experiments which had for their object the preparation of fluoxyvanadates isomorphous with the fluoxyniobates. In order to trace the resemblance between the vanadates, phosphates, and arsenates, it is evidently necessary to confine attention to the tribasic ortho-salts, since acid ortho-vanadates cannot be prepared, and on the other hand the pyro- and meta-arsenates are not known in the crystalline state. The only tribasic orthovanadates, phosphates, or arsenates soluble in water, are those of the two alkalies sodium and petassium, and of these only sodium is available, since the potassium salts crystallise with great difficulty. A careful examination of the sodium vanadates was therefore undertaken with a view of comparison, and with good success; for out of the four hydrates of the above salt described in this communication, viz:—

(1.) $Na_3VO_4.12H_2O$, hexagonal prisms,
(2.) $Na_3VO_4.10H_2O$, rhombic dodecahedra,
(3.) $Na_3VO_4.10H_2O$, hexagonal plates,
(4.) $Na_3VO_4.8(?)H_2O$, rhombic plates,

salts exist in the phosphorus and arsenic series exactly corresponding to three of the vanadates, viz., Nos. 1, 2, and 4. Double salts of sodium phosphate with sodium fluoride have several times been described, which *all* crystallise in regular octohedra, though remarkably different compositions are ascribed to them. These descriptions, however, all apply to one and the same body, and it is shown in the paper that to this there are exactly corresponding salts containing in place of phosphorus, arsenic and vanadium, thus: $2Na_3VO_4.NaF.19H_2O$. From these experiments the conclusion is evident that the salts of vanadic acid are not, as would appear, entirely different to those formed by phosphoric and arsenic acids, but do exactly resemble them in those cases where corresponding members are known.

Discussion.

The President thought that the arguments brought forward by Mendelejeff and also by Rammelsberg in favour of placing vanadium along with molybdenum and chromium, seem hardly strong enough to assail the position which Roscoe's researches have assigned to it in the periodic system, and according to which it is classed along with phosphorus and arsenic. The results of the author's researches seem to afford a farther confirmation;

and, indeed, no other proof appears in this respect so convincing as the comparison of the three minerals—pyromorphite, mimetesite, and vanadinite.

OBITUARY.

FREDERIC FIELD, F.R.S.

We regret having to put on record the death of Mr. Frederic Field, F.R.S. The deceased was one of the original members of the Chemical Society, and held in succession the Professorships of Chemistry at St. Mary's Hospital and at the London Institution. At one time he filled the post of British Vice-Consul at Caldera, Chili, where he acquired very extensive and accurate information concerning the mineral resources of that republic. He was, indeed, justly considered our chief authority on South American mineralogy, mining, and metallurgy. His memoirs and papers on different branches of chemistry amount to 55 in number. He died on Friday, 3rd inst., after a prolonged illness.

NOTICES OF BOOKS.

A Practical Treatise on the Fabrication of Glue. By F. Dawidowsky. Translated from the German, with extensive additions, by William T. Brannt. Philadelphia: Henry Carey Baird and Co. London: Sampson, Low, and Co. 1884.

A practical book on the manufacture of glue and gelatine, like the one before us, cannot but be of considerable value to our technologists, containing, as it does, an account of the most recent improvements that have been introduced into this industry in the United States, where the fabrication of glue has reached its highest development, and is conducted on such a large scale as to render competition with American glue makers a difficult matter.

This treatise, which is essentially of a practical nature, begins with a discussion of what is glue, its sources, its mode of action, and the changes that occur in glue under different circumstances. With regard to the latter interesting point, that in its various transition stages the modification of glue differ only in physical properties, we cannot agree with this statement of the author, that it is "as is the case with starch, which, without suffering an alteration in its composition, appears as dextrin and grape sugar, or, as with cellulose, which, without altering its composition, can be transformed into amyloid and grape sugar," changes which are anything but illustrative of the author's meaning.

In the chapters that follow, the selection and working up of raw material for glue making, and the arrangement of a glue factory, as well as the fabrication of gelatine, are fully described with the aid of drawings.

Not the least important chapters in this book are those on the applications of gelatine and glue, and on the manufacture of cements. In the former, receipts are given for the preparation of chrome, tungstic, cologne, and mouth glues, and holicolle, gelatine veneers, and the imitations of malachite, marble, ivory, &c.; in the latter chapter innumerable receipts for the preparation of cements are collected together, a list so complete, that, as the preface tells us, "whether the article to be mended be a fine china vase or a defective iron casting," a receipt for a suitable cement will be found.

From the chapter on the present status of the fabrication of glue, we learn that in the United States alone there are 82 factories engaged in the manufacture of glue, employing altogether about 2000 hands, the value of the annual produce being something like one million sterling, facts which show what a very large industry this has become in America.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

Note.—All degrees of temperature are Centigrade unless otherwise expressed.

Comptes Rendus Hebdomadaires des Séances, de l'Académie des Sciences. Vol. c., No. 13, March 30, 1885.

Reply to the Remarks of M. Troost on Chloral Hydrate.—M. Friedel.—No new facts are here brought forward.

Heat of Combustion of the Coal of Ronchamp.—M. Scheurer-Kestner.—The author obtains 4115 calories from the combustion of 0·4507 grm. of coal, the ash having been deducted. The interest of these results consists in showing that the combustion heat of coal is much higher than it has been generally supposed. Practically the consequences are important, since the question is to know if in steam boilers with the best external furnaces a greater or less quantity of heat is not lost by radiation. If the figures obtained by M. Meunier-Dollfus and the author are correct this loss does not fall short of 25 per cent.

The Formation of Magnesium Hydrocarbonate.—R. Engel.—The hydrocarbonate obtained in the cold in the presence of much water differs in its composition as well as in its properties from the hydrocarbonate obtained in heat. It dissolves in a solution of magnesium bicarbonate, and if the latter is in excess it is quickly and totally converted into the neutral carbonate. It even slowly absorbs from the air the quantity of carbonic acid needful for its saturation.

Reduction of Mannite by Formic Acid.—Ad. Fauconnier.—The reactions which appear to take place are the following:—dehydration of mannite and formation of mannitane; etherification of the mannitane with production of mono- and di-formene; pyrogenous decomposition of these two ethers; dehydration of mannitane and formation of isomannide.

Formation of Creatines and Creatinines.—E. Duvillier.—The author has obtained a novel creatinine:—α-ethyl-amido propiono-cyamidine. When cyanamide is caused to react upon the amidic acids there is formed a creatinine with the amidic acids of ordinary ammonia and with those of compound ammonias, except methyl-glycocoll and α-methyl-amido-propionic acid, which give rise to creatines.

Journal für Praktische Chemie.
New Series, Vol. xxx., Parts 10 and 11.

This issue, which has appeared only after the first three parts of vol. xxxi., contains a portrait and biography of the late Prof. Hermann Kolbe, from the pen of his friend, co-editor, and successor, Ernst von Meyer.

Contributions to the Determination of the Chemical Constitution of Isatine.—H. Kolbe.—Already inserted, pp. 157 and 169.

On Isatic Acid: a Sequel to the foregoing Memoir.—Communicated by E. von Meyer.—The assumption that isatic acid is an ortho-azo-benzoyl-carbonic acid, does not harmonise with its readiness to take up water, and to resolve itself into carbonic and anthranilic acids, since such want of permanence in an azo acid is exceedingly singular. The question whether isatic acid is identical with its isomer, carbon-anthranilic acid, is more important, seeing that both agree in their fusion and decomposition points, and in their ready decomposition into carbonic and anthranilic acids. The author has caused certain experiments to be undertaken for the decision of this point, of which a preliminary notice is here given. Herr G. Schmidt, on examining the transformations of isatic acid in contact with oxidising and reducing agents, has obtained an unexpected result. Chromic acid or potassium permanganate, allowed to act upon isatic acid in hot glacial acetic acid, decomposes it in part, with escape of carbonic acid. The product, which crystallises in colourless prisms, has the same composition as isatic acid. An identical compound is formed by treating the latter with acetic acid and zinc powder, at about 60°, carbonic acid being here also given off. This new substance is simply carbon-anthranilic acid.

Journal de Pharmacie et de Chemie.
No. 6, March 15, 1885.

Formation of the Nitro-prussides without the Use of Nitric Acid.—Professor H. O. Jensen.—The author has obtained the nitro-prusside by passing the current of two Bunsen elements through 25 c.c. of a solution of potassium ferrocyanide for seventy-two hours. A drop of the liquid gave the usual reaction with sulphides very energetically. Solutions of potassium ferro- and ferricyanides likewise yielded nitro-prusside on being heated with sodium and calcium hypochlorites.

No. 7, April 1, 1885.

The Origins of Alchemy.—M. Berthelot.—The introduction to a work just published.

Seeds of Chaulmoogra (*Gynocardia odorata*).—E. Heckel and F. Schlagdenhauffen.—A lengthy examination of the matters extracted from these seeds by water, petroleum, ether, chloroform, and methylic alcohol.

Identity of Diastase in Living Beings.—E. Bourquelot.—The author shows that diastase is one of those chemical agents which determine phenomena necessary for the maintenance of life, and consequently identical in all living beings.

Crystalline Colchicum.—MM. Laborde and Houdé.—A physiological and toxicological study.

Poisoning by Boric Acid.—Dr. Molodenkoff.—The symptoms produced are obstinate vomiting, hiccough, erithma of the face, and diminution of the cardiac pulsations.

Bulletin de la Société d'Encouragement pour l'Industrie Nationale. 3rd Série. Tome xii., January, 1885.

Distribution of the Nitrogen in Coal during Distillation.—M. W. Forster.—From the *Journal of the Chemical Society*.

Revue Universelle des Mines, de la Metallurgie, &c.,
January and February, 1885.

This issue contains no chemical matter.

Cosmos les Mondes.
New Series, No. 9, March 30, 1885.

This issue contains no chemical matter.

Archives Neerlandaises des Sciences Exactes et Naturelles.
Vol. xix., Part 4.

This issue contains no chemical matter.

Part 5.

This issue also contains no chemical matter.

MISCELLANEOUS.

The Buxton Sewage Process.—In our notice of this process we omitted to state that the letter in the *Leek Times*, from which our information was derived, was written by Mr. Wardle, and that the analysis of the effluent water was executed in his laboratory. As regards the extreme purity of the water we may point out that the original sewage must have been very light, containing, as is stated in Mr. Wardle's letter, only 1·60 part of albumenoid ammonia per million, or 0·112 grain per gallon, the the average of 12 determinations of sewage taken at the southern outfall being 0·263 grain. It will also be seen that as the mineral water contains only 1·2 grain of iron per gallon, a very considerable proportion of water, free from organic pollution, must thus have been introduced, necessarily diluting the sewage and improving, *pro tanto*, the effluent.

MEETINGS FOR THE WEEK

Monday, 20th.—Medical, 8.30.
—— Society of Arts, 8. (Cantor Lectures). "Photography and the Spectroscope," by Capt. W. de W. Abney.
Tuesday, 21st.—Institution of Civil Engineers, 8.
—— Pathological, 8.30.
—— Meteorological, 7.
—— Royal Institution, 3. "Digestion and Nutrition," by Prof. Gamgee.
Wednesday, 22nd.—Society of Arts, 8. "Technical Education, with reference to the Apprenticeship System," by Henry Cunynghame.
Thursday, 23rd.—Royal Institution, 3. "Natural Forces and Energies," by Prof. Tyndall.
—— Royal, 4.30.
—— Society of Arts, 8. "The Chemistry of Ensilage," by Frederick J. Lloyd.
Friday, 24th.—Royal Institution, 9. "British Fossil Cycads," by Mr. W. Carruthers.
—— Quekett Club, 8.
Saturday, 25th.—Royal Institution, 3. "Fir-trees and their Allies," by Mr. W. Carruthers.
—— Physical, 3. "On the Theory of Illumination in a Fog," by Lord Rayleigh, F.R.S. "On Compound Dynamo Machines," by Prof. A. W. Rucker, F.R.S. "On the Determination of the Heat Capacity of a Thermometer," by J. W. Clarke.

UNIVERSITY OF LONDON.

NOTICE IS HEREBY GIVEN, that the next Half-yearly Examination for MATRICULATION in this University will commence on MONDAY, the 15th of June, 1885.—In addition to the Examination at the University, Provincial Examinations will be held at University College, Aberystwith; University College, Bangor; Queen's College, Birmingham; University College, Bristol; University College, Cardiff; the Ladies' College (Cheltenham (*for Ladies only*); St. Gregory's College, Downside; New College, Eastbourne; the Literary Institute, Edinburgh; the Royal Medical College, Epsom; the Yorkshire College, Leeds; University College, Liverpool; the Owens College, Manchester; the School of Science and Art, Newcastle-on-Tyne; Firth College, Sheffield; Stonyhurst College; and St. Edmund's College, Ware.

Every Candidate is required to transmit his Certificate of Age to the Registrar (University of London, Burlington Gardens, London, W.) at least *one Calendar Month* before the commencement of the Examination.

ARTHUR MILMAN, M.A., Registrar.

April 13th, 1885.

THE CHEMICAL NEWS.

Vol. LI. No. 1326.

ON THE
USE OF SULPHURIC ACID IN PLACE OF NITRIC ACID TO OXIDISE SULPHIDES FOR THE ESTIMATION OF THEIR METALS.

By EDWARD DIVERS, M.D., and TETSUKICHI SHIMIDSU, M.E.

That sulphuric acid has not come into general use for oxidising minerals in preparation for their analysis seems to us remarkable, for it possesses over nitric acid several advantages with apparently no drawbacks. This notice of its advantages we venture to publish, only with the desire of calling attention to the subject, being quite aware that what we have to state must be already for the most part known.

1. *Greater Simplicity of Treatment.*—The action of nitric acid upon powdered sulphides is, at first, so rapid and fierce as to endanger the success of the operation through loss of substance. Not so with sulphuric acid. The mineral, finely-powdered, as usual, may be mixed with the concentrated acid without fear of any such instant and violent action setting in, even when the mineral is blende. The necessary quantity of sulphuric acid may be added, too, all at once, for, unlike nitric acid, it will not be sensibly evaporated at the heat required. Heat by sand-bath may be at once applied, and only in the case of blende or galena is it well—though not necessary—to moderate this for a few minutes. The requisite degree of heat is indicated by its effect in maintaining a gentle effervescence of sulphur dioxide. The acid need not be boiled. Stirring or agitation is not needed. Loss by effervescence should be guarded against by the usual precautions, but this is easy to do because the effervescence is always moderate. The oxidation is finished when sulphur dioxide is no longer to be smelt.

When the action of the sulphuric acid is over, the product is ready for boiling out with water, but when nitric acid has been used what remains of this must generally be expelled by sulphuric acid before the oxidised residue is ready for boiling out.

Arsenic, as well as antimony, selenium, and tellurium, is obtained as its lower oxide, more or less completely dissolved in the sulphuric acid, ready at once for immediate treatment, instead of needing reduction, as is the case when nitric acid has been the oxidising agent.

2. *No Trouble with Free Sulphur.*—Every one is familiar with the trouble and delay caused by the separation of sulphur when nitric acid acts on sulphides. Nothing of the kind occurs when sulphuric acid is used as the oxidising agent. A little sulphur sublimes into the upper part of the vessel, but this is of no moment because it encloses no metal sulphide. When copper and iron pyrites are mixed with a moderate amount of gangue, as usual, they do not show any separation of sulphur in the solution; when unmixed with gangue they become slightly coherent and spongy, but even then yield no liquid sulphur, and make no greater resistance to the action of the acid than before. Blende and galena at first give off some hydrogen sulphide, and form a little sulphur in the acid, but this soon disappears, partly by oxidising and partly by subliming. When afterwards the acid is diluted and the walls of the vessel washed down, the little sublimed sulphur present in most cases gets mixed with the insoluble matters, but its presence does not signify of course under such circumstances.

3. *Much less Expenditure of Time.*—When effervescence is kept up, oxidation by sulphuric acid takes only half an hour, and then all is ready for the analysis. How long oxidation may take with nitric acid cannot be fixed for comparison, and besides is familiar to all. When at length it is quite over, or over except for some drops of yellow sulphur, there comes the expulsion of the nitric acid by sulphuric acid, before the product is ready for analysis.

4. *Less Reagents Used.*—The quantity of sulphuric acid taken in the after-treatment when nitric acid has been used to oxidise can be but little less than that wanted when the sulphuric acid itself serves as the oxidising agent, so that the expenditure of the nitric acid is saved, and with it the entrance into the solution of the impurities the acid may contain.

5. *Comparative Absence of Fumes.*—When sulphuric acid is used, insignificant quantities of it volatilise, while, as is well known, abundance of nitric acid evaporates into the atmosphere when it is the oxidising agent employed. Of the gases which necessarily escape in the two cases, the oxides of nitrogen are of course far more objectionable than sulphur dioxide.

Having pointed out the advantages which we find in the use of sulphuric acid instead of nitric acid, we may make note of one or two facts observed by us which appear to be but little if at all known.

Action of Sulphuric Acid upon Ferrous Sulphate and upon Iron Pyrites.—Ferrous sulphate can apparently be rendered anhydrous by treating the hydrated salt with warm concentrated sulphuric acid, but in "Watts's Dictionary" it is stated that for this purpose the acid must be strong and boiling. It is perhaps, therefore, new to point out that when the acid is nearly boiling-hot it freely *oxidises* ferrous sulphate to ferric sulphate. Hence all the iron found in commercial sulphuric acid after concentration is always ferric sulphate.

The action of sulphuric acid on pyrites gives only ferric sulphate, but from the fact we have just mentioned, this throws no light upon the constitution of the pyrites.

Action of Sulphuric Acid upon Mercury Sulphide.—Sulphuric acid exerts very little action upon vermillion until it is boiling hot, but it then acts freely, converting the vermillion into a dazzling white substance, consisting largely of mercuric sulphate, but also, to some extent, generally, of a substance which slowly yields up a little black mercuric sulphide when it is treated with potassium hydroxide solution. This substance is most probably a *sulphato-sulphide* corresponding to the nitrato-sulphide formed by the prolonged action of nitric acid upon black mercuric sulphide, which is said by Fresenius to be $Hg(NO_3)_2,2HgS$, like the chloro-sulphide, $HgCl_2,2HgS$. If so, its formula should be $HgSO_4,2HgS$. It appears to be decomposable by the further action of sulphuric acid, but we are not certain of this.

DETERMINATION OF MIXTURES OF MILK-SUGAR AND CANE-SUGAR.

By ALFRED W. STOKES and R. BODMER.

The determination of milk-sugar alone, as pointed out by Muter and Soxhlet, varies greatly in the results obtained by different experimenters, unless an invariable method with tedious precautions is followed. But when there is a mixture of milk-sugar with cane-sugar the difficulties are such that usually only the milk-sugar is estimated and the cane-sugar taken by difference.

Messrs. A. W. Stokes and R. Bodmer have introduced a volumetric method whereby such mixtures can be rapidly and accurately determined (*Analyst*, April, 1885). This method is especially useful in the estimation of cane-sugar added to milk, *e.g.*, condensed milk. They employ Pavy's ammoniated Fehling solution, prepared thus—

Cupric sulphate (crystallised)	34·65	grms.
Rochelle salt	170	,,
Potash	170	,,

made up to a litre.

Of this 120 c.c. are added to 400 c.c. of ammonia (sp. gr. 0·880), and made up to a litre.

10 c.c. of this solution = 0·005 grm. of glucose.

The milk, or other solution, largely diluted, is placed in a burette, to the point of which hangs by a small piece of india-rubber tube a flask of about 100 c.c. capacity. The india-rubber tube is compressed by a screw-clip. A side tube allows the escape of the ammonia gas evolved. Into the flask 40 c.c. of the standard solution are placed; this is boiled, and the sugar solution run in till the blue colour disappears. It being exceedingly easy to run in too much, 0·2 c.c. less than the quantity found is placed in another flask with 40 c.c. of the blue fluid, and the whole boiled. If the blue colour does not go, the former titration was correct within 0·1 c.c. Another portion of the same diluted milk is boiled for ten minutes with 2 per cent of citric acid. This inverts completely the cane-sugar, but does not touch the milk-sugar, even if the boiling be continued for thirty minutes. The liquid is cooled, neutralised with ammonia, and titrated as in the first instance.

Two readings of the burette are thus obtained; the first due to the action of the milk-sugar, the second due to the combined action of milk-sugar and glucose.

The authors found that milk-sugar has 52 per cent of the reducing power of glucose on this blue liquid.

So that by a short calculation, or by reference to a table given in the paper, the proportions of milk-sugar and cane-sugar present are easily found. Examples are given showing the methods of calculation and the results obtained. The milk or sugar solution should be diluted so that from 6 to 12 c.c. are needed to decolourise 40 c.c. of the blue liquid. The advantages claimed for the process are the rapidity, ease of working, and accuracy of results that can be obtained by any ordinary operators.

The fluid used will keep of standard strength indefinitely, the end point of the reaction is sharply marked, not being obscured by the usual dirty red precipitate; it is essential that it should remain clear the whole of the time.

LONDON WATER SUPPLY.

Report on the Composition and Quality of Daily Samples of the Water Supplied to London for the Month ending March 31st, 1885.

By WILLIAM CROOKES, F.R.S.,
WILLIAM ODLING, M.B., F.R.S., F.R.C.P.,
Professor of Chemistry at the University of Oxford.
and C. MEYMOTT TIDY, M.B., F.C.S.,
Professor of Chemistry and of Forensic Medicine at the London Hospital; Medical Officer of Health for Islington.

To Colonel Sir Francis Bolton, *Water Examiner, Metropolis Water Act*, 1871.

London, April 10th, 1885.

Sir,—We submit herewith the results of our analyses of the 188 samples of water collected by us during the past month, at the several places and on the several days indicated, from the mains of the seven London Water Companies taking their supply from the Thames and Lea.

In Table I. we have recorded the analyses in detail of samples, one taken daily from March 1st to March 31st inclusive. The purity of the water, in respect of organic matter, has been determined by the Oxygen and the Combustion processes; and the results of our analyses by these methods are stated in Columns XIV. to XVIII.

We have recorded in Table II. the tint of the several samples of water, as determined by the colour-meter described in a previous report.

In Table III. we have recorded the oxygen required to oxidise the organic matter, and the quantities of free oxygen present in the whole of the samples submitted to analysis.

Of the 188 samples examined, the whole were found to be perfectly clear, bright, and well-filtered.

The mean amount of organic carbon in the Thames-derived waters for March was practically identical with that for February, viz., 0·18 in 100,000 parts of the water.

Considering the condition of the river during the month, and the additional care needful to effect good filtration, it is noteworthy that not one of the 188 samples examined by us contained so much as a trace of suspended matter.

We are, Sir,
Your obedient Servants,
William Crookes,
William Odling,
C. Meymott Tidy.

A CATALOGUE OF CHEMICAL PERIODICALS.*

By H. CARRINGTON BOLTON, Ph.D.,
Professor of Chemistry in Trinity College, Hartford, Conn.

(Continued from p. 188).

Explanation of Signs.

+ Following a date signifies current at the date in question.
|| Following a date signifies publication discontinued.

14. Annales de Chimie, ou Recueil de mémoires concernant la chimie et les arts qui en dépendent [*from* vol. xxxiii.,], et spécialement la pharmacie. Par de Morveau, Lavoisier, Monge, Berthollet, de Fourcroy, de Dieterich, Hassenfratz, et Adet. 96 vols., 8vo. Paris, 1789-1816.
    Vols. i., ii., *and* iii., *were reprinted at Paris in* 1830.
    Tables des matières. 3 vols. Paris, 1801, 1807, 1821.
    Continued under the title;
    [a] Annales de chimie et de physique, par Gay-Lussac et Arago. Deuxième série. 78 vols., 8vo. Paris, 1817-'40.
    Tables des matières. 3 vols., 8vo. Paris, 1831-'41.
    Continued under the title:
    [b] Annales de chimie et de physique, par Arago, Chevreul, Dumas, Pélouze, Boussingault, Regnault. Avec une revue des travaux de chimie et de physique publiées à l'étranger, par Wurtz et Verdet. Troisième série. 69 vols., 8vo. Paris, 1841-'63.
    Tables des matières. 2 vols., 8vo. Paris, vols. i.-xxx., 1851; vol. xxxi.-lxix., 1866.
    Continued under the title:
    [c] Annales de chimie et de physique, par Chevreul, Dumas, Pélouze, Boussingault, Regnault, avec la collaboration de Wurtz. Quatrième série. 30 vols., 8vo. Paris, 1864-'73.
    Table des matières. Vols. i.-xxx. Paris, 1874.
    [d] Cinquième série. Par Chevreul, Dumas, Boussingault, Wurtz, Berthelot, Pasteur, avec la collaboration de Bertin. 30 vols., 8vo. Paris, 1874-'84.+
15. Annali di Chimica [*from* vol. iv.], e storia naturale, ovvero raccolta di memorie sulle scienza, arti, e

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* Advance-proofs from the *Annals of the New York Academy of Sciences*

manufatture ad esse relative, di L. Brugnatelli. 21 vols., 8vo. Pavia, 1790-1802. ‖
Vol. xxi. contains index.

Annali di Chimica Applicata alla Medecina. Polli. *See* Giornale di farmacia, chimica, e scienza accessorie.

16. Annali di Fisica, Chimica, e Matematiche, col bullettino dell'industria, meccanica, e chimica, diretti dall' ingegnere G. A. Majocchi. 28 vols., 8v. Milano, 1841-'47.

Continued under the title:

[a] Annali di fisica, chimica, e scienze affini, col bollettini di farmacia e di technologia, redatti da G. A. Majocchi e F. Selmi [*from* vol. iii.], e P. A. Boscarelli. Seconda serie. 4 vols., 8vo. Torino, 1850. ‖

Annali di Fisica, dell'Abbate F. C. Zantedeschi. *See* Raccolta fisico-chemico-italiano.

17. Annals of Chemical Medicine, including the application of chemistry to physiology, pathology, therapeutics, pharmacy, toxicology, and hygiene. Edited by J. L. W. Thudicum. 2 vols., 8vo. London, 1880-'81. +

18. Annals (The) of Chemical Philosophy [&c.]. By W. Maugham. 2 vols., 8vo. London, 1828-'29.

19. Annals of Chemistry [&c.], by de Morveau, Lavoisier [*and others*]. Translated from the French. 1 vol., 8vo. London, 1791.
This is a translation of the fifth volume of the Annales de Chemie.

20. Annals (The) of Chemistry and Practical Pharmacy. Being a weekly summary of the discoveries of philosophers, chiefly continental and transatlantic, in their applications to the chemistry of medicine, agriculture, manufactures, and to the several branches of physics, electricity, galvanism, photography, &c. 1 vol., 8vo. London, 1843.

(To be continued.)

ACCIDENTAL EXPLOSIONS PRODUCED BY NON-EXPLOSIVE LIQUIDS.*

By SIR FREDERICK ABEL, C.B., D.C.L., F.R.S.

(Continued from p. 187).

The disaster on board the *Triumph*, combined with the fact that this xerotine siccative had been issued to H.M. ships generally, the authorities and officers of the navy having been in ignorance as to its dangerous nature, redirected official attention to the loss of the *Doterel* on April 26, 1881, while at anchor off Sandy Point, by an explosion, or rather by two distinct explosions following each other in very rapid succession, which caused the death of eight officers and 135 men, there being only twelve survivors of the crew. The inquiry by court-martial into the catastrophe had led to the conclusion that the primary cause of the destruction of that vessel was an explosion of gas in the coal bunkers, caused by disengagement of fire-damp from the coal with which these were in part filled. Its distribution through the air in the bunkers and in air spaces adjoining the ship's magazine, was believed to have taken place to such an extent as to produce a violently explosive mixture, and that this had become accidentally inflamed, causing a destructive explosion, which was followed within half a minute by the much more violent explosion of the ship's magazine containing four or five tons of powder, to which the flame from the exploding gas-mixture had penetrated.

The circumstances elicited by the inquiry, coupled with the information, relating to explosions known to have occurred in coal-laden ships, which had been collected by a Royal Commission in 1876 (of which the lecturer was a member), combined to lend a considerable amount of probability to the view adopted by the court-martial in explanation of an accident for which there appeared to be no other reasonable mode of accounting.

The conclusion arrived at led to the appointment of a commitee under the presidency of Admiral Luard (of which Professor Warington Smyth and the lecturer were members) to inquire into the probabilities of coal-gas being evolved, and of an explosive gas-mixture accumulating in consequence in the coal-bunkers of ships of war, and into the possible extent and nature of damage which might be inflicted upon ships of war by explosions due to the ignition of such accumulations. The committee were also instructed, in the event of their finding that H.M. ships were liable to exposure to danger from such causes, to consider and devise the means best suited for preventing dangerous accumulations of gas in the coal-bunkers as distributed over the various parts of the ship in the different classes of vessels composing the Royal Navy.

The committee instituted a very careful inquiry, and a series of experimental investigations, including the firing of explosive gas-mixtures, in large wrought-iron tanks in the first instance, and afterwards in one of the large bunkers, empty of coal, in an old man-of-war, which afforded some comparison with the condition, as regards the relative strength or powers of resistance of the surroundings, and with the position, relatively to the ship's magazine, of the particular bunker in the *Doterel* in which it was thought the explosion might have originated. The results of these experiments could not be said to do more than lend some amount of support to the belief that effects of the nature of those ascribed to the first explosion in the *Doterel* might have been produced by the ignition of a powerfully explosive gas-mixture, contained in the middle or athwart-ship's bunker of the ship. The committee's experimental Investigations for ascertaining the best general method of securing the efficient ventilation of the coal bunkers in different classes of men-of-war was, however, of considerable advantage in leading to the general adoption of arrangements in H.M. ships whereby the possible accumulation in the bunkers of gas which may be liable to be occluded from coal after its introduction into them is effectually prevented, and the occurrence of the kind of accident guarded against, of which there are several on record, due to the ignition of explosive mixtures which have been produced in coal-bunkers.

Although the inquiry instituted by the court-martial in August, 1881, into the loss of the *Doterel* was apparently very exhaustive, some significant facts connected with the existence of a supply of xerotine siccative in the ship, which appear to have had a direct bearing upon the occurrence of the disaster, only came to light accidentally in January, 1882. A caulker formerly on the *Doterel* but then employed in the *Indus*, recognised, while some painting was being done in that ship, a peculiar odour (as he called it, "the old smell") which he had noticed in the lower part of the *Doterel* the night before the explosion; on inquiry as to the material which gave rise to it, he learned that it was due to some of the same material, xerotine siccative, that had caused the explosion in the *Triumph*. Upon this being communicated to the authorities, an official inquiry was directed to be held, and it was then elicited that the very offensive smell due to the crude petroleum spirit, of which this xerotine siccative mainly consisted, had been observed not only by this man (who, in his evidence before the court-martial, had not alluded to the circumstance), but also by several others in the *Doterel*, between decks, the night before the explosion; that, on the following day, a search was made for the cause of the odour, and that a jar containing originally about a gallon of the fluid, which was kept in a space at the bottom of the foremast together with heavy stores of various kinds, was found to have been cracked, the princi-

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* A Lecture delivered before the Royal Institution, March 13, 1885.

pal portion of its contents having leaked out into the bottom of the ship. The cracked jar was handed up to the lower deck with the siccative still leaking from it, and orders were given to throw it overboard on account of the bad small which it emitted; this was done within a very few minutes after the jar had been removed, and the first explosion occurred almost directly afterwards. Instructions had been given to clear up the leakage from the jar after the hatch of the mast-hole had been left off a little time, and it appeared that a naked candle had been given to the man who handed the jar up out of the small store-hold described by that name. There appears very little room for doubt than an explosive mixture of the vapour and air had not only been found in the particular space where the jar was kept, but that it had also extended through the air-spaces at the bottom of the ship towards and underneath the powder-magazine, so that even the air in the latter may have been in an explosive condition, as many hours had elapsed between the time when the smell of the petroleum spirit-vapour was first noticed and when the first explosion occurred.

The special committee which had inquired into the possibility of the occurrence of a violent gas explosion in the coal-bunkers of the *Doterel*, was directed to institute experiments with a view of ascertaining whether the vapour evolved by this xerotine siccative would, in the circumstances indicated by the official inquiry, have furnished an explosive gas-mixture possessing sufficient power to have produced the effects resulting from the first explosion on the *Doterel*, and to have exploded the powder-magazine. A preliminary experiment showed that when a small quantity of the liquid was spilled at one extremity of a wooden channel 7 feet long and 2·5 inches by 3 inches in section, the vapour had diffused itself in the space of three minutes throughout the channel to such an extent, that. on a light being applied at one end, the flame travelled along very rapidly to the other end, igniting a heap of gunpowder which had been placed there. Some of the liquid was also spilled upon the bottom of a very large sheet-iron tank, and after this had remained closed for about twenty-four hours, being exposed on all sides to the cool air of an autumn night, and therefore not under conditions nearly so favourable to evaporation as those obtaining in the hold of a ship, the application of flame produced an explosion of such violence as to tear open the tank. Experiments were also made with the liquid in an old man-of-war, under conditions somewhat similar to those which existed in the *Doterel*, and destructive effects were obtained of a nature to warrant the conclusion that the first explosion in the *Doterel* might have been due to the ignition of an explosive mixture of the air in the confined space at the bottom of the ship, with spirit vapour furnished by the liquid which had leaked out of the jar.

It is very instructive, as indicating the manner in which volatile liquids of this class may, if their nature be unsuspected, be the causes of grave disasters, to note that, while stringent regulations apply and are strictly enforced in our men-of-war in connection with the storage and treatment of explosives and inflammable bodies carried in the ship, the introduction into the service of this highly volatile liquid, and its supply to ships in small quantities, was speedily followed by two most calamitous accidents because the material was only known under the disguise of a name affording no indication of its character. Its dangerous nature had consequently escaped detection by the officials through whose hands it had passed, the makers of the preparation having, in a reprehensible manner which cannot but be stigmatised as criminal, withheld the information which most probably would have, at the outset, acted as a prohibition to the adoption of this material by the Admiralty for use in ships, or which would, at any rate, have led to the adoption of very special precautions in dealing with this material.

Although not initiated, nor attended, by an explosion, the accident which in December, 1875, caused the loss, by fire, of the training-ship *Goliath*, off Grays (near Gravesend), and the death of several of the boys by drowning, claims notice as an illustration of the facility with which, by heedlessness, or inattention to obvious precautions, accidents may be brought about in the use as an illuminating agent of mineral oil or petroleum, even where these are of such low volatility, or high "flashing-point," as to entitle them to be considered as safe, under all ordinary conditions, as vegetable or animal oils. The evidence elicited at the coroner's inquest showed that one of the boys of the *Goliath*, whose duty it was, at the time, to trim the lamps used in the ship, to place them in position, and remove and extinguish them in the morning, and to whom this work had been but recently allotted, let fall a lamp which, after having lowered the flame, he had carried from its assigned position into the lamp or trimming-room, and which he could hold no longer on account of its heated state. The heated oil was scattered upon the floor and was apparently at once inflamed by the burning wick of the lamp; the floor of the room was, it appears, much impregnated with oil which had been let drop from time to time by lads employed upon the work of lamp-trimming; hence the flame attacked the apartment generally with considerable rapidity, and the wind blowing at the time caused the fire to spread through the vessel so very quickly as to compel many of those composing the crew to jump overboard, and to render the rescue of the boys from burning or drowning a difficult matter. The occurrence of this accident was made the occasion, in some of the public papers, to decry petroleum oil as a dangerous illuminating agent, although it was proved that the particular oil used at the time when the fire occurred had so unusually high a flashing-point that the consequent inferiority of its burning quality had been made the subject of complaint. This low volatility of the oil has been occasionally regarded as one very important element of safety in reference to its employment in lamps, but the lecturer will presently have to refer to circumstances which do not altogether substantiate this view. At any rate, however, although the heated oil which was spilled on to the floor from the lamp was in a condition favourable to immediate ignition by the burning wick, it is not at all likely that the fire would have extended almost at once with uncontrollable violence, especially in face of the excellent discipline and arrangements in case of fire which were shown to have existed in the *Goliath*, if the scrupulous cleanliness and care had been enforced which were essential in a room where lamp filling and trimming were regularly carried out, and where it was necessary to keep some supply of oil for current consumption. Instead of this, the floor, and probably, therefore, other parts of the room, appear to have been in a condition most favourable to the rapid propagation of the flame; moreover, the evidence as to proper care having been taken to keep the supply of oil required for current use in such a way as to guard against its being accidentally spilled, or to impress the boys employed upon the work with the great importance of care and cleanliness, was by no means satisfactory, and there can be little doubt that this catastrophe has to be classed among the numerous accidents of a readily avertible kind which have contributed to lead the public to form an exaggerated estimate of the dangerous character of petroleum oil as an illuminant.

The employment of liquid hydrocarbons as competitors with animal and vegetable oils in lamps for domestic use is of comparatively recent origin, although petroleum or mineral naphtha in its crude or native conditions was used at a very early date in Persia and in Japan, in lamps of primitive construction, while in Italy it was similarly employed about a century ago.

The application of the most volatile products of coal distillation to illuminating purposes in a crude way appears to have originated, so far as Great Britain is concerned, with the working of a patent taken out by Lord Dundonald in 1781, for the distillation of coal, not with a view to producing gas, but for the production of naphtha, brown or heavy oil, and tar.

In 1820, at about the time when gas-lighting was being established in London, his successors sold coal-naphtha in the metropolis for illuminating purposes; but the first really successful introduction of naphtha as an illuminating agent was made by Mr. Astley shortly afterwards, through the agency of the so-called Founders blast-lamp, which came into use for workshops and yards in factories, and of the naphtha lamp of Read Holliday, of Huddersfield, with which we are well acquainted to this day, as, although it never became a success, for internal illumination of houses, it still continues in extensive use, almost in its original form, by itinerant salesmen and showmen.

In the Founders lamp a current of air, artificially established, was made to impinge upon the flame and thus to greatly assist the combustion of the crude heavy oil used in it.

In the Holliday naphtha-lamp the spirit finds its way slowly from the reservoir through a capillary tube to a small chamber placed at a lower level, which has a number of circumferential perforations, and is in fact at the same time the burner of the lamp and the vapour-producer which furnishes the continuous supply of illuminant, the liquid supplied to the chamber being vaporised by the heat of the jets of flame which are fed by its production.

Between 1830 and 1850 the knowledge of the production not only of oils, but also of paraffin, by the distillation of coal or shale, became considerably developed by Reichenbach, Christison, Mitscherlich, Kane, du Boisson, and others, and the practical success attained by the latter was soon eclipsed by that of Mr. James Young, who after establishing oil distillation at Alfreton from the Derbyshire petroleum, began to distil oils from the Bathgate mineral in 1850, and soon developed this industry to a remarkable extent.

The first lamps for burning liquid hydrocarbon which competed for domestic use in this country with the superior kinds of lamps, introduced after 1835, in which animal or vegetable oils were burned (solar lamps and moderator lamps), were the so-called camphine lamps (known as the Vesta and Paragon lamps) in which carefully rectified oil of turpentine was used. They gave a brilliant light, but soon acquired an evil reputation as being dangerous and liable, upon the least provocation, especially if exposed to slight draughts, to fill the air with adhesive soot-flakes.

After a time Messrs. George Miller and Co., of Glasgow (who held for a time the concession of the products manufactured by Mr. Young), tried with some amount of success to use the lighter products from the boghead mineral in the camphine lamp, but the chief aim of Mr. Young appears to have been to produce the heavier oil suitable for lubricating purposes, the light oil or naphtha meeting with an indifferent demand as a solvent, in competition with coal-tar naphtha, in the manufacture of india-rubber goods. He, however, himself used the mineral oil produced at Alfreton in Argand lamps in the earliest days of his operations; a small sale of the Bathgate oil took place about 1852-3 for use in Argand lamps, and the earliest description of lamp employed in Germany, where the utilisation of mineral oil as a domestic illuminant was first developed, appears to have been of the Argand type.

In 1853 a demand sprang up for the lighter paraffin oils in Germany. For three or four years previously, a burning oil was distilled from schist or brown coal at Hamburg by a Frenchman named Noblée, who gave it the name of *photogene*. The existence in Glasgow of a considerable supply of the oils became known to a German agent, and after they had been exported from Glasgow to Hamburg for a considerable time it was found that the chief purchaser was Mr. C. H. Stobwasser, of Berlin, who appears to have originated the really successful employment of mineral oils in lamps for domestic use, and to have been the first to bring out the flat-wick burners for these oils. After a time Messrs. Young discovered the destination of their oil, and, having brought over a number of German lamps, for which a ready sale was found, commenced the lamp manufacture upon a large scale, and rapidly developed the trade in mineral (or paraffin) oil for burning purposes, which attained to great importance some time before the American petroleum oils entered the market. In 1859 a firm in Edinburgh supplied Young's company with nearly a quarter of a million burners for lamps, and it was not until 1859 that the foundation of the United States' petroleum industry was laid by Colonel G. L. Drake, who first struck oil (in Pennsylvania) at a depth of 71 feet, obtaining at once a supply of 1000 gallons per day. The lamps first used in America were probably of German make, but it need hardly be said that the lamp manufacture was speedily developed to a gigantic extent in that country. Some of the earliest lamps for burning mineral oil in dwellings which were produced in Germany and in Scotland possess considerable interest as ingenious devices for promoting the perfect and steady combustion of the oil, and as attempts to dispense with the necessity of the chimney for the production of a steady light. In one of these a small lamp was introduced into the base or stand of the lamp proper, and a tube passed from over this little lamp, through the oil reservoir into the burner, so as to supply the latter with heated air. In another, a small fan or blower with simple clockwork attached, to keep it in rapid motion, is placed in the stand, and supplies the flame with a rapid current of air. Among other workers at the perfection of mineral oil lamps was the late Dr. Angus Smith, who produced a double-wick lamp some years before the beautiful *duplex* lamps were first manufactured by Messrs. Hinks. Some of the more recent American lamps exhibit decided improvements in the details of construction of the oil reservoirs, the wick-holders, and elevators, the arrangements for extinguishing the lamps, &c.

It does not come within the province of this discourse to deal with the marvellous development of the petroleum industry of America, where the region of Western Pennsylvania now furnishes about 70,000 barrels of oil per day, having up to the 1st January, 1884, yielded a total of 250,000,000 barrels. Nor would it be relevant to enter upon the equally interesting topic of the recent extraordinary progress of the same industry in the Caucasus, which is chiefly due to Messrs. Nobel Brothers, further than to refer to the fact that the Baku petroleum lamp oil, which supplies the entire wants of Russia, and is gradually obtaining a footing in Germany, and even here, appears, notwithstanding its high specific gravity, to be suitable for mineral oil-lamps of the ordinary construction. This seems to be partly owing to the comparatively small proportion of lamp oil that is extracted from the crude Baku petroleum, in consequence of which the variety of hydrocarbons composing that product of distillation which is used for illuminating purposes presents a narrower range than is the case in the ordinary American petroleum oil of commerce. It has also been established by careful observations which Beilstein has instituted, that some American oil which is specifically lighter than the Baku oil is not so readily carried up to the flame as the latter, by the capillary action of the wick. Mr. Boverton Redwood has carried out some instructive experiments, employing different kinds of wick as syphons, and measuring the quantity of different descriptions of oil drawn over in corresponding periods of time by the different wicks. These showed that the Baku kerosine was drawn over with decidedly greater rapidly than samples of American petroleum of ordinary quality, but that, on the other hand, a sample of American kerosine of the highest quality exhibited a corresponding superiority over the Baku oil experimented with. The nature and behaviour of the wick plays a most important part in determining the efficiency and also the safety of a mineral oil or petroleum-lamp, as will be presently pointed out.

Ever since paraffin or petroleum oils which may be included under the general designation of mineral oils first assumed importance as illuminating agents, accidents connected with their use have continued to claim prominence among those casualties of a domestic character which tend to cast suspicion on the safety of the material dealt with, or of the method of employing it, under the ordinary conditions fulfilled by its careful use.

The employment as an illuminant of the most volatile portions of petroleum which are classed as spirit or naphtha has been chiefly limited to the wickless Holliday lamp, in which a small continuous supply to a chamber heated by the lamp flame which surrounds it, furnishes the vapour which maintains that flame, and to the small so-called sponge lamps or benzoline lamps, of which the body is filled with fragments of sponge, and which is intended to be charged only with as much spirit as the sponge will hold thoroughly absorbed; the small flame at the top of the wick-tube being fed by the gradual abstraction of the liquid from the soaked sponge by the wick of sponge or asbestos which fills the tube. An ingenious application of naphtha as an illuminant consists in filling a reservoir with sponge fragments, kept soaked with the spirit, the vapour of which descends by its own gravity through a narrow tube at the base of the reservoir, and issues from a fish-tail burner under sufficient pressure to produce a steady flame for some time.

The only real danger which may attend the use of the little sponge lamps arises from accidental spilling of spirit used for filling them in the neighbourhood of a flame, or from carrying out the operation of filling in the vicinity of a light. Indeed, such casualties as have been attendant upon the use of petroleum spirit as an illuminant have been mainly connected with the keeping and handling of the supplies of this very volatile liquid, and are largely attributable to want of caution or to forgetfulness. The salutary regulation prescribed by law, that vessels containing the spirit shall bear a conspicuous label indicating its dangerous character, has undoubtedly operated very beneficially in diminishing the frequency of accidents with it, by constantly admonishing to caution. It is a matter for much surprise and regret that the manufacturers of a class of miners' safety lamps, consisting of modifications of well-known types, with the ordinary oil lamp replaced by the sponge lamp, in which petroleum spirit is burned, should have allowed trade interests to induce them to mislead those who use these lamps with regard to the nature of the illuminant supplied with them, by devising a name for it which gives a false indication of its nature, being designed to create the belief that it is an article of special manufacture, allied in character to a comparatively very safe oil largely used in miners' lamps, while in reality it is a well-known article of commerce, the safe storage and use of which demand special precaution and vigilance.

The lecturer took occasion to point out here, ten years ago, that a large proportion of the accidents arising out of the employment of petroleum or paraffin-lamps were not actually due to the occurrence of explosions. Thus the incautious carrying of a lamp, whereby the liquid is brought into contact with the warm portion of the lamp close to the burner, may give rise to a liberation of vapour which in escaping from the lamp may be ignited, causing an outburst of flame which may alarm a nervous person and cause the dropping or overturning of the lamp. The accident which occurred in some apartments in Hampton Court Palace, in December, 1882, and gave rise to a somewhat alarming fire, appeared almost beyond doubt to have originated from the employment by a domestic servant of a contrivance in which petroleum spirit was used for heating water; but as petroleum-lamps were used in the particular residence where the fire actually occurred, public correspondence ensued regarding the dangers attending the use of such lamps, although all which were known to have been on the premises were forthcoming after the fire and found to be intact. There was, at any rate, no evidence whatever adduced in support of an assumption that the casualty was due to the explosion of a lamp, and other instances might be quoted in which the breaking out of a fire, or the destruction of or injury to life, which had evidently been caused by upsetting or allowing to fall a petroleum-lamp, has been erroneously ascribed to an explosion.

There are, however, numerous casualties which have been unquestionably caused by the occurrence of explosions in lamps, and which have in many cases been followed by the ignition of the oil, and the consequent loss of life or serious injury to those in the immediate vicinity of the accident. Careful inquiries have of late been instituted into casualties of this kind, and in many instances the explosions have been distinctly traceable to some immediate cause. In the great majority of cases they occur some considerable time after the lamp was first kindled, and when the supply of oil remaining in the reservoir has been but small. Occasional examples of the reverse are, however, met with. Thus, last spring, a man and his young son were sitting at the table reading, his wife being also close at hand, when a paraffin lamp which had just been lighted exploded, and the room was at once set on fire by the burning oil which escaped. The husband and wife fled from the room, both being slightly injured, but the child was unable to escape from the flame, and was burned to death. The oil used in the lamp was of a well-known brand, having a flashing-point ranging from 73° to 86° degrees F., and assuming that the recently lighted lamp had been filled with oil, and was untouched at the time of the explosion, no satisfactory explanation can be given of the accident, unless perhaps the reservoir had been so completely filled with the oil that the expansion of the liquid, on its becoming slightly warm, exerted sufficient force to determine the fracture of the glass at some part where a flaw or crack existed.

A lamp accident which occurred last July, at Barnsbury, causing the death of a woman and her husband, appears, on the other hand, distinctly traceable to the production of an explosion in the reservoir of the lamp. The latter was stated to have been alight but a short time, when, the husband being already in bed, the wife, in her nightdress, attempted to blow out the flame of the lamp; the man heard a report, and looking towards the lamp, saw his wife in flames. He proceeded at once to her rescue, and was severely burnt in extinguishing the flames in which she was enveloped. The woman died in a few hours, and the man succumbed three days later to the injuries received. There being no witness to the accident, there is no evidence against the supposition that, on the occurrence of a slight explosion in the reservoir in the lamp, the woman, having hold of it when attempting to blow it out, may have upset it, or tilted it, so as to cause the oil to flow out and become inflamed. The lamp may have become fractured by the explosion; but whenever such a result has been produced the lamp had always been burning some time, so that there was considerable air-space which could be filled by an explosive atmosphere; whereas, in this case, the evidence appears positive as to the lamp having been full of oil when lighted.

In another fatal case of a lamp explosion in the same month, at Mile End, the accident was also caused by the attempt on the part of a woman to blow out the lamp before going to bed. In this case the lamp had been burning for three hours; the husband of the sufferer was in bed asleep in the room at the time, and the woman being unable to give any account of the occurrence, the only information elucidating it was furnished by the daughter, to the effect that the lamp had been burning for three hours, and that it was the habit of her mother to extinguish the lamp by first lowering the wick and then blowing down the chimney.

(To be continued).

On the Hydrates of Chromium Sesquichloride.—M. l'Abbé Godefroy.—The author describes the preparation and properties of three hydrates containing respectively 20, 12, and 8 mols. of water. The solution of all three is exempt from dichroism.—*Bull. Soc. Chim.*

PROCEEDINGS OF SOCIETIES.

CHEMICAL SOCIETY.

Thursday, April 16th, 1885.

Dr. W. H. PERKIN, F.R.S., Vice-President, in the Chair.

CERTIFICATES were read for the first time in favour of Messrs. Thomas J. Greenway, 28, Wilkinson Street, Sheffield; Harry Haslett, Chatham Brewery, Chatham; Arthur Richardson, 35, Canynge Square, Clifton.

The following papers were read:—

30. "*A Crystalline Tricupric Sulphate.*" By W. H. SHENSTONE.

When crystals of copper sulphate and a little water, or the crystals of copper sulphate alone, are heated up to temperatures approaching 200° C., masses of minute emerald-green crystals are formed They are insoluble in water, and give on analysis numbers which lead to the formula $CuSO_4 2CuH_2O_2$.

An account of their chief characters is given.

Mr. H. H. Miers, M.A., has examined and reports on their crystallography. The crystals are on the rhombic system. They exhibit no evident relation to brochantite.

31. "*A Modified Bunsen Burner.*" By W. H. SHENSTONE.

A description of a form of Bunsen burner in which a ring of small or large flames can be made to play upon the crucible to be heated. The arrangement can be adjusted so as to apply the heat, from above, to the surface of liquids, so that evaporation, &c., in analytical operations can be more easily carried on without spurting. It may also be used to ignite at any desired temperature in the ordinary way.

32. "*The Chlorination of Phloroglucol.*"

The author has studied the chlorination of phloroglucol in suspension in carbon tetrachloride, at temperatures below zero. Under these circumstances he finds that the chlorination of the phenol precedes, as a distinct stage in the reaction, the disruption of the benzene-ring, with formation of chloracetic acids, which Hlasiwetz showed some years since to be the ultimate result of the decomposition. The trichloro-derivative, $C_6Cl_3(OH)_3$, the formation of which thus constitutes the first phase of the reaction, was obtained crystallising with $3H_2O$ in fine needles. In its properties and reactions it is very similar to the well-known tribromophloroglucol, and it is to be considered as the corresponding trichloro-derivative. In conclusion the author points out the bearings of his results upon the problems, as yet only partially solved, of the constitutional relationship of the trioxy-benzenes and their derivatives, to which he is continuing to devote attention.

33. Note on "*The History of Thionyl Chloride.*" By C. SCHORLEMMER, F.R.S.

The author in this note refers to certain paragraphs of a recent paper by Dr. Divers (*Trans.*, 1885, 205), relating to the preparation of thionyl chloride.

To the statements contained in that paper the author wishes to add the following:—(1.) Thionyl chloride was first obtained by Hugo Schiff, from Kremer's product (*Annalen*, cii., 111). (2.) Carius prepared it by heating a mixture of 1 mol. of calcium sulphite and 2 mols. of phosphorus pentachloride, but could not, like Schiff, obtain it quite free from phosphorus oxychloride (*Annalen*, cvi., 328). (3.) He found that when 3 mols. of calcium sulphite are heated with, not 2, but at least 3 mols. of phosphorus oxychloride, hardly any sulphur dioxide is formed, the product consisting of calcium phosphate and thionyl chloride, which by fractional crystallisation can easily be separated from the excess of oxychloride used (*Annalen*, cvi., 330).

34. "*On the Reaction of Selenious Acid with Hydrogen Sulphide and of Sulphurous Acid with Hydrogen Selenide.*" By E. DIVERS and T. SHIMIDZU.

It is true that hydrogen sulphide precipitates from selenious acid under favourable conditions selenium and sulphur in the proportion of one atom of the former to two of the latter, and that hydrogen selenide may precipitate from sulphorous acid, sulphur and selenium in the proportion of one atom of the former to two of the latter; but the physical characters of the precipitates show that these precipitates are mixtures, not compounds. In this communication the authors state that in precipitating a hot solution of selenious acid, very much sulphur volatilises with the steam.

The authors find that, especially in warm solutions, selenious acid readily oxidises hydrogen sulphide to *sulphuric acid*. It is therefore easy to obtain from a solution of selenious acid a precipitate containing much less than two atoms of sulphur to one of selenium.

Sulphur, they find, instantly decomposes moist hydrogen selenide, forming hydrogen sulphide and selenium. From an excess of sulphur dioxide solution, hydrogen selenide precipitates pure selenium. Hence it is easy to get a precipitate from sulphurous acid containing far more than two atoms of selenium to one of sulphur.

Attention is called to the apparently forgotten experiments of Ditte. He obtained an unstable compound of one atom of selenium to one atom of sulphur, with properties quite distinct from those of a mixture. The authors believe this monosulphide to be the only one of selenium.

The preparation of a monoselenide of iron, almost pure, is described; and from this the authors prepared their hydrogen selenide.

35. "*On a New and Simple Method of Quantitative Separation of Tellurium and Selenium.*" By E. DIVERS and M. SHIMOSÉ.

It has long been known through Rose that the presence of hydrochloric acid is essential to the precipitation of selenium by sulphurous acid. Rose has also pointed out that in presence of dilute sulphuric acid selenium is precipitated by sulphurous acid, but only imperfectly.

The authors show that in presence of comparatively concentrated sulphuric acid the precipitation of selenium is complete by sulphurous acid. They further find that tellurium is not in the least precipitated by sulphurous acid in presence of sulphuric acid unless hydrochloric acids is also present, when its precipitation becomes complete. The application of these facts to the separation of selenium and tellurium is obvious. The mixed substances are heated with concentrated sulphuric acid, which readily oxidises them and for the most part dissolves them. To the acid liquor, sulphur dioxide solution is added until the volume is increased five-fold. This precipitates all selenium. Dilute, and filter; add hydrochloric acid and more sulphur dioxide solution, when the whole of the tellurium will be thrown down. Test analyses are given

The next Meeting of the Society will be held on Thursday, May 7th, when there will be a ballot for the election of Fellows. (Important.)

The following paper will be read:—

"On the Action of the Copper-Zinc Couple on Organic Bodies" (Part X.). Benzyl Bromide. By Dr. J. H. Gladstone, F.R.S., and Mr. Tribe.

ERRATUM.—P. 189, col. 1, line 26 from top, *for* "densities" *read* "boiling-points."

Experiments with Manures containing Sulphocyanides.—Dr. G. Klien.—Water containing per litre 0·1 grm. ammonium sulphocyanide proved fatal to well-grown plants of barley and oats. Young plants perished if 0·01grm. ammonium sulphocyanide was used. The introduction of superphosphates containing sulphocyanides should be discountenanced.—*Biedermann's Centralblatt.*

NOTICES OF BOOKS.

Annual Report of the National Board of Health, 1882. Washington: Government Printing Office, 1883.

AMONG the numerous lengthy reports contained in this bulky volume there is one by Prof. Mallet, of the University of Virginia, on Water Analyses, which should certainly be read and studied by many chemists.

In no other country has the subject of Water Analyses been so much studied and written about as in England, but it is to be feared that the stimulus to the production of such a large literature on this matter as we possess has been in some considerable respect tainted by party spirit. The rivalry that has existed in chemical circles between the partisans of the different methods employed in the analysis of water has produced bad as well as good fruit, as in all other spheres, and it is a matter of no little difficulty for a competent but unprejudiced chemist who may be called upon to undertake the examination of a number of waters for a purely sanitary purpose to judge what analytical methods he ought to adopt in order to obtain the most reliable data for forming his opinion.

An unprejudiced investigation of the various methods used in water analyses, especially when exhaustive and containing much matter that is new, is a desideratum at the present day, more particularly for chemists in this country.

This very long report by Prof. Mallet, to which we refer, consists of an exhaustive criticism of all the principal analytical processes involved in the examination of potable waters, and, with the simultaneous microscopical and pathological study by Prof. Martin of the waters used for the analytical experiments, make this report one of the most valuable and complete investigations that has yet appeared on potable waters.

With our limited space we can do little more than quote or state a few of the principal points which appear to us to be most likely to interest chemists in this country. Some of these points doubtless are already known, as the report bears a somewhat late date, but we trust that the more general results contained in Prof. Mallet's valuable criticism may be some day rendered more accessible than bound up in this huge tome.

In this investigation the experiments connected with the "combustion process," the "albumenoid ammonia process," and the "permanganate process" were in charge of Mr. W. A. Noyes, Dr. C. Smart, U.S.A., and Dr. J. A. Tanner, U.S.N., who worked independently and in different laboratories. The waters examined were of nine classes, which included natural waters believed to be good, and doubtful; natural waters believed to have occasioned disease; artificial waters containing organic matter of a vegetable and of an animal origin; and solutions in distilled water of pure chemical substances.

From the numerous facts fairly deducible from Prof. Mallet's experiments we select the following:—

> "Clear proof that loss of organic matter does occur during the evaporation of a water prior to combustion of the residue by Dr. Frankland's method, contrary to what has always been claimed by Dr. Frankland."
>
> "Evidence of a source of serious error in the determination of nitrogen by the same process, there being a notable gain of nitrogen from the atmosphere."

With regard to these two errors in the combustion process, Prof. Mallet considers that his results support Dr. Tidy's opinion that the results obtained for nitrogen are less reliable than for carbon; but, indeed, the loss of carbon and increase in nitrogen occur simultaneously, or, as he puts it—"The weaker the solution, or, in other words, the larger the quantity of water to be evaporated for a given amount of organic matter, the less is the amount of organic carbon obtained, indicating relatively greater loss of this element. On the contrary, the weaker the solution, or the greater the quantity of water to be evaporated, the larger is the figure for organic nitrogen, indicating relatively greater gain of this element from the atmosphere, and probably, in some cases, less dissociation of ammonical salts when the amount of free ammonia found is considerable." Then follows the very vital inference—"If the usual interpretation of Dr. Frankland's C : N ratio be applied, the curious and important result of these sources of error, affecting the two elements in opposite directions, follows that the more dilute an organically polluted water is, the more animal-like in origin will the polluting material seem to be, while the stronger it is the more will be the tendency to refer the contamination to a vegetable source." An inference quite the reverse of that required for safety.

In the case of the "albumenoid ammonia" process, the results are likewise dependent on the strength of the solutions; the weaker the solutions the higher the results obtained both for free and albumenoid ammonia, the influence probably being due to imperfect condensation. On the other hand, by the permanganate process, the results are much less influenced by varying dilution within the limits of the experiments than in the other processes.

Prof. Mallet's report also supplies "much fuller information than has hitherto been obtained as to the extent to which definite substances belonging to various chemical classes, and including some of the known products of putrefaction are attacked by potassium permanganate in acid and in alkaline solution," and "an extended comparison of the practical results of the Frankland, Tidy, and Wanklyn processes as applied to a series of waters from known sources and of known sanitary (or insanitary) character; also to waters artificially polluted with sundry forms of manufacturing refuse, and with forms of organic matter liable to be encountered in connection with ordinary water supply."

On these points Professor Mallet concludes that, of the several processes, the combustion process for organic carbon may, with proper precautions, be made to give more valuable indications than the permanganate process, and its results for organic nitrogen more valuable than the indications of the albumenoid ammonia process. Again, he has not found satisfactory evidence in favour of Wanklyn's view that in distilling with alkaline permanganate definite and simple fractions of the nitrogen of organic matter are given off as albumenoid ammonia; such results may be varied at pleasure by slight modifications of the experimental conditions. The value of this process he considers to depend more upon watching the progress and rate of evolution of the ammonia than upon attempting to estimate the total amount. The same statement applies to the permanganate process; watching the rate of oxidation of the organic matter in preference to determining its absolute amount. Besides, in this process the results are liable to be influenced by the temperature prevailing at the time of the experiment.

Dr. Tidy's claim for the permanganate process, a most important one if conclusively proved to be true, that it enables a distinction to be drawn between "putrescent and easily oxidisable" and "non-putrescent and less easily oxidisable" organic matters, is next considered.

One of the important features in this investigation is the simultaneous biological examination of the waters using the concentrated solutions evaporated at a low temperature for subcutaneous injection of rabbits, and the best thing we can here do is to quote from the general summary of the report the results obtained by this new and highly important adjunct to chemical examination of waters. "Among other results obtained in this connection, it was observed that while 'in many cases the waters which produced most decided effects upon the rabbits contained *very large* amounts of organic matter, so large as to probably invalidate a comparison with the natural waters, or with much more dilute specimens of artificial preparation;' yet, on the other hand, in several instances, on comparing the pathological results from three different strengths of a solution of the same organic material, it was found that it is not the strongest which has produced the most marked effects. This apparent anomaly lends support to the idea that it is not mainly the quantity of organic matter, but the presence and nature of low organisms which render drinking-water unwholesome."

"The results obtained as to the presence of nitrates and nitrites in waters received from various parts of the country, with medical evidence as to their having in all probability actually caused disease, strongly suggested the idea that these salts, instead of merely affording evidence of the *previous* contamination of the water with nitrogenous matter, as is generally assumed, may possibly afford evidence of the presence of *noxious organisms* in the shape of those now proved to be concerned in the process of nitrification."

It is but natural that Prof. Mallet after his long investigation of the several processes for examining waters should propose many improvements, and these he gives in detail, but for a description of which we must refer to his report. One proposal, however, to evaporate the water in a partial vacuum in the Frankland process, and so presumably avoid one source of error in this process, the increase of nitrogen from the surrounding atmosphere, has, at least in part, been employed by, we think, Dr. Mills. This chemist covering his evaporating dish with a tall glass shade, over which a current of water trickles.

As we have already said, this report of Prof. Mallet's forms one of the most valuable contributions to the subject of water analyses, and we cannot but think his results and conclusions will make themselves be felt before long.

CORRESPONDENCE.

ALUMINIUM SULPHATE.

To the Editor of the Chemical News.

SIR,—On looking up the various aluminous compounds in the English translation of Wagner's "Technology," I am struck by two strange errors, which should be corrected in the next edition.

1. *Aluminium Sulphate.*—He rightly attributes to this salt the following formula, $Al_2(SO_4)_3 18H_2O$; this would point to the following percentage composition, viz:—

Alumina	15·44
Sulph. acid	35·98
Water	48·02
	99·44

Whereas he gives—

Alumina	18·78
Sulph. acid	38·27
Water	42·95
	100·00

I know its composition is uncertain; but what I want to direct attention to is, that the formula given and the percentage composition do not correspond.

2. *Sodium Aluminate.*—He gives, as the formula of this salt, $Na_6Al_2O_6$, and then says that the percentage composition of the commercial salt is—

Alumina	48
Soda	44
Impurities	8
	100

And the pure salt—

Alumina	52·79
Soda	47·21
	100·00

Whereas, according to his formula, it would be—

Alumina	35·6
Soda	64·4
	100·0

The percentage composition he gives—and this indeed is corroborated by Knapp—would rather lead to the formula $Na_6Al_4O_9$. I believe that while fresh in the dry state the composition of the aluminate is that of Roscoe, $Na_2Al_2O_4$, but that on solution, particularly if kept in a concentrated state, it slowly changes to the formula $Na_6Al_2O_6$, the solution possessing, when first dissolved, a composition leading to the formula $Na_6Al_4O_9$, and gradually tending, with deposition of aluminium hydroxide, to Grove's composition.—I am, &c.,

F. MAXWELL-LYTE.

Cotford, Oakhill Road, Putney, S.W.
April 14, 1885.

PHENOL-PHTHALEIN AS AN INDICATOR.

To the Editor of the Chemical News.

SIR,—In the same way as phenol-phthalein can be used for the determination of the mono-carbonates in the presence of bicarbonates, it may also be used for the determination of mono-sulphides in the presence of bisulphides, or sulphydrates of the alkalies or of the alkaline earths. If to a solution of a monosulphide, either alone or mixed with other sulphides, hydrochloric acid is added, the red colour of phenol-phthalein will disappear when all the monosulphide is changed into sulphydrate, the reaction being quite similar to that represented in CHEMICAL NEWS, vol. li., p. 161. If then the sulphuretted hydrogen is driven off by adding an excess of acid and boiling, the excess of acid may be measured by normal caustic soda, and the quantities of monosulphide and other sulphides in the sample can be calculated by the data so obtained.—I am, &c.,

EUGENE T. TRACHSEL,
Analytical Chemist.

44, Victoria Terrace, Neath.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

NOTE.—All degrees of temperature are Centigrade unless otherwise expressed.

Comptes Rendus Hebdomadaires des Séances, de l'Académie des Sciences. Vol. c., No. 14, April 6, 1885.

The Ammonia-Soda Process.—The President, in announcing the death of M. Rolland, late a member of the Mechanical Section, ascribed to him, in conjunction with M. Schlœsing, the invention of the ammonia process for the manufacture of alkali. The same claim was made on his behalf by M. Phillips in the *éloge* pronounced at his funeral.

On Complementary Manures.—M. de Gasparin.—The author insists on the necessity of supplying to any soil those elements of plant-food in which it is deficient and of omitting those which are already present in superabundance in an available state. To add potash to the soil of the vineyard of Lachryma Christi, which already contains 3 per cent of that base in an available condition, or phosphoric acid to the basaltic acids of Pont-du-

Chateau in Limagne, would be "carrying water to the river."

Liquefaction and Solidification of Formene and of Nitric Oxide.—K. Olzewski.—The author, unable to procure absolutely pure formene, prepared it both by the ordinary method, which yields a product slightly contaminated with acetone and hydrogen (the latter of which is not readily removable), and by the method of Gladstone and Tribe, which yields a product containing the vapour of methyl iodide. For determining the congelation point he employed the gas prepared from sodium acetate. The critical point was observed at a pressure of 80 m.m. of mercury and a temperature of −185·8°. At 5 m.m. of mercury and a temperature of −201·5° there was formed a white snow-like mass. Nitric oxide was prepared by heating ferrous sulphate with dilute nitric acid. In the experiments it was very important to prevent the entrance of atmospheric air. The critical point was observed at 71·2 atmospheres and −93·5. At a pressure of 138 m.m. of mercury and a temperature of −167·0° solidification ensued. If the apparatus is kept free from air the liquefied gas is colourless, but if air has been permitted to enter it takes a greenish tint and holds in solution a trace of nitrous anhydride. M. Cailletet remarked that he had first made known the procedures for the liquefaction of ethylene and formene and the use of these condensed gases for obtaining the liquefaction of oxygen. He had determined the critical point of ethylene and the tension of these gases at different temperatures, and had shown that formene sligtly compressed and refrigerated in boiling ethylene at the atmospheric pressure is resolved into an extremely mobile liquid, which in returning to the gaseous state gives cold sufficient to liquefy oxygen. M. Cailletet had also shown that the figures published cannot be accepted without reserve, because none of the methods for preparing these gases yield a pure product, and a very small quantity of a foreign gas is sufficient to modify the critical point.

On the Amides of the Oxalo-adipic Group.—L. Henry.—These amides may be referred to two groups: the group of even amides or the micro-crystalline type, and the odd or macro-crystalline type.

Biedermann's Central Blatt fur Agrikultur Chemie.
Vol. xiii., part 8.

Influence of the Chemical and Physical Properties of Soil upon its Power of Evaporation.—Carl Eser.—The author sums up the results of his experiments in the following series of propositions:—(1.) The evaporation of water from a soil depends chiefly on the quantity of moisture it contains, the greater the proportion of water the greater the evaporation. Hence the latter increases, under conditions otherwise identical, with the capacity of the soil for water and with the quantity of water arriving from above and below. In a saturated condition soils of different physical nature exhale almost equal quantities of water. (2.) Evaporation from the surface continues as long as it remains moist. The loss occurring is replaced by the capillary ascent of water from the lower levels in all cases where the proportion of water exceeds 50 per cent of the capacity of the soil for water. If the moisture falls below this proportion the ascent of water ceases, and, in consequence, the surface of the soil dries up. The evaporating stratum lies deeper; so much the deeper as the soil contained originally less moisture, and the quicker the desiccation of the upper layer has proceeded. (3.) By the desiccation of the upper layers of the soil, the direct action of the evaporative factors (solar action, wind, &c.), and consequently the evaporation itself, are much diminished. The latter then depends chiefly on the warming of the soil and on the current of air in the soil depending on its porosity. The thicker the desiccated layer becomes, and the lower, consequently, the evaporating stratum descends, the less water is given off by the soil to the atmosphere. If the desiccation of the top soil is promoted by loosening, the evaporation diminishes afterwards considerably. (4.) Soils in which—from causes above stated—the evaporation has been very intense lose, on further desiccation, smaller quantities of water than such in which it proceeded at first more rapidly. (5.) The evaporative capacity of soils, other circumstances being the same, is effected by the extent of the surface. Hence, soils with a rough, uneven surface give off a larger quantity of water than those with a smooth level surface. (6.) Among the physical conditions of importance, the first rank belongs to the structural conditions of the soil and its proportion of organic matters, as, hereupon, both the capacity for moisture and the capillary conduction are dependent. The evaporation generally increases with the fineness of the particles; only if a certain degree is exceeded, it decreases within certain limits. Stony ground loses less quantities of water than stoneless. Of the various ingredients of soils, humus exhales the largest and sand the smallest proportions of water, clay holding an intermediate position. (7.) The evaporation from a soil is the greater the darker its colour. (8.) If ground water is present the evaporation will be the smaller, the greater the distance between the surface of the earth and the level of the sub-soil water. (9.) The covering of the soil with plants, or with lifeless objects, has a great influence. Soil covered with living plants evaporates most; that covered with lifeless objects (straw, manure, stones, &c.) the least, the bare ground taking a mean position. (10.) If the loss of moisture from the surface is compensated by capillary ascent of water from below, a portion of the soluble salts are conveyed upwards. (11.) Manuring with substances containing soluble salts in proportions customary in practice has no effect on evaporation. (12.) Among the different exposures a southern slope exhales the greatest quantity of water, then follows the eastern slope, next the western, whilst land inclined northwards loses least. (13.) As regards the different inclinations of land, with a southern exposure in our latitudes, evaporation, during the greater part of the year, is the greater the greater the angle of inclination.

The Injurious Action of Ammonium Sulphocyanide on Vegetation.—Dr. J. König.—The experiments showed distinctly the poisonous action of the sulphocyanides. Superphosphates containing any such salt, if used at all, should be applied to the land some weeks before sowing.

Manural Experiments at Grignon.—P. P. Déhérain.—The results of the experiments are given in tables which do not admit of abstraction.

The Need for Nitrogen in Cultivated Plants.—Prof. Thaer.—The author concludes that if nitrogen is abundantly supplied in manures, nature gives it also in abundance and inversely.

Influence of Acid Fumes upon Vegetation.—J. von Schroeder.—One part of sulphurous acid in 54,000 of air is capable of occasioning serious damage to plants in a short time. Against hydrochloric acid they are less sensitive. Coniferous trees are most sensitive to sulphurous acid, then deciduous trees, whilst ordinary field plants resist longest. Oaks, planes, elms, poplars, and mountain-ashes resist better then birches and beeches. Fruit-trees are very sensitive; plums and cherries more so than pears and apples.

Bulletin de la Société Chimique de Paris.
Vol. xliii., No. 5, March 5, 1885.

The Combinations of Tellurous Acid with Acids.—D. Klein and Jules Morel.—The authors describe the action of nitric acid upon tellurium, tellurous anhydride, and the basic nitrate, and sulphate of tellurium dinoxide.

Experiments on Fatty Matters.—Ch. Dubois and L. Padé.—The authors have made a microscopic examination of the crude fatty acids, and have obtained microphotographs which they laid before the Society. They append also to their paper curves indicating the quantity of fatty acids yielded by the different fats; their points of solidification and of fusion; the solidification-points of the crude fatty acids, and of the fatty acids obtained from the decomposition of the magnesium and lead salts.

Formation-heat of certain Salts of the Amines in Dilute Liquids.—A. Muller.—This memoir does not admit of useful abstraction.

Analysis of a Chrysotile (Fibrous Serpentine having the Aspect of Asbestos), a Fibrous Silica resulting from the Action of Acids upon Serpentines.—A. Terreil.—The silica which remains after the magnesia has been removed by means of boiling acids retains the original fibrous form of the mineral.

Researches on the Bromised Phenols.—E. Werner.—A determination of the fusion-heat, the specific-heat, and the neutralisation-heat of mono-, di-, and tri-bromophenol.

Combination-heats of the Acid Compounds of Hydrogen.—D. Tommasi.—In this paper the author proposes the following principle:—If we add to the combination-heat of a salt M, the thermic constant of its metal, we obtain a value equal to that of the combining-heat of the potassium-salt whence we set out, whenever the coefficient of dissociation of the salt M is the same as that of the corresponding potassium compound. But if, on the contrary, the coefficient of the salt M is not the same as that of the potassium-salt, we have a different value which will be negative if the coefficient of dissociation of the potassium-salt is greater than that of the salt M, and positive in the contrary case.

A New Laboratory Apparatus for the Continuous Production of Gases.—M. Gaston Tissandier.—An illustrated account of the appliance in question.

A Contribution to the Study of the Alkaloids.—M. Oechsner de Coninck.—An account of the quinoleïc alkeloids, of cicutine and nicotine. The author concludes that the pyridic alkaloids present a combination of characters which may thus be summarised:—They are polymerised under the influenced of sodium, yielding dipyridines and dipyridyles. Their chloroplatines are decomposed by boiling water. They combine directly with the alcoholic iodides; if distilled with potassa in presence of a small quantity of water they furnish dihydrides and colouring matters. He then gives an account of the general properties of the pyridic hexahydrides or volatile alkaloids properly so-called, and of the quinoleic alkaloids.

Russian Correspondence.—Session of Sept. 13/25, 1884.—M. Selinsky sent in a memoir on the addition-product of methylamine and β-methylglysidic acid. M. Lubavine communicated the results of an analysis of the nitre-earths of Kunia-Urguentsch in Turkestan.

At the Session of October 4/16, 1884, M. Schalfeelf sent in a paper on the specific volumes of chlorine, bromine, and iodine when entering into molecules containing carbon. He concludes that the specific volumes of the haloids are multiples of the number 3. Their aptitude of entering into combination with a volume greater than 3 is directly as the atomic weights of these elements.

M. E. Wagner contributed a paper on the oxidation of the acetones of the chromic mixture.

M. Alexeef discussed the conditions determining the stability of a combination in presence of one of its integrant parts.

M. Konoraloff described the researches of M. Backhuis Roozeboom on certain hydrates.

M. Goldstein described his preliminary researches made in concert with M. Damisky on the height to which a solution rises in capillary tubes.

M. Mendelejeff pointed out that the phenomenon of compression which occurs on the formation of solutions presents a great resemblance to the phenomenon which takes place on mixing spherical bodies possessing unequal diameters.

MISCELLANEOUS.

National Association of Science and Art Teachers.—A special general meeting of the London Section of the National Association of Science and Art Teachers will be held at the Technical College, Cowper Street, Finsbury, on Saturday next, 25th inst., at 7.30 p.m., when Sir H. E. Roscoe, V.P.R.S., President of the Association, will deliver an address on the objects of the Association. All interested in the teaching of Science and Art are cordially invited to attend. The above Association was started in Manchester about three years ago for advancing the teaching of Science and Art and improving the position of teachers. It already possesses strong sections in Manchester, Liverpool, Birmingham, and other large towns in the North, and the London section was started last year.

NOTES AND QUERIES.

*** Our Notes and Queries column was opened for the purpose of giving and obtaining information likely to be of use to our readers generally. We cannot undertake to let this column be the means of transmitting merely private information, or such trade notices as should legitimately come in the advertising columns.

White Ear-Wires in Russia and Perforation of the Ears.—A Russian lady has informed me that when the ear-lobes are pierced in her country, amongst "the upper class" the operation is performed by simply passing "wires of white metal" through the ear-lobes, which mode causes no inflammation. Can any correspondent kindly supply chemical name for the metal used, for my informant could not give it? The fair Muscovite mentioned also that her ears were bored through this means, and she experienced no sensation of pain at any time, even during the pressing of the metal. Upon the whole, my friend is in favour of the Russian method of piercing the ears, which prevents blood being drawn. The next day these rings are pressed tightly through the ears. I presume chemists from Russia correspond with the Chemical News, and can supply the information asked for.—Peter Benoit.

MEETINGS FOR THE WEEK

Saturday, 25th.—Physical, 3. "On the Theory of Illumination in a Fog," by Lord Rayleigh, F.R.S. "On Compound Dynamo Machines," by Prof. A. W. Rucker, F.R.S. "On the Determination of the Heat Capacity of a Thermometer," by J. W Clarke.
— National Association of Science and Art Teachers. 7.30. Address by Sir H. E. Roscoe.
Monday, 27th.—Medical, 8.30.
— Society of Arts, 8. (Cantor Lectures). "Photography and the Spectroscope," by Capt. W. de W. Abney.
Tuesday, 28th.—Institution of Civil Engineers, 8.
— Royal Medical and Chirurgical, 8 30.
— Society of Arts, 8. "The Federation of the Empire," by J. E. Gorst, M.P.
— Royal Institution, 3. "Digestion and Nutrition," by Prof. Gamgee.
Wednesday, 29th.—Society of Arts, 8. "Researches on Silk Fibre," by Thomas Wardle, F.C.S.
— Geological, 8.
Thursday, 30th.—Royal Institution, 3. "Natural Forces and Energies," by Prof. Tyndall.
— Royal, 4.30.
Friday, May 1st.—Royal Institution. Annual Meeting, 1.30. "Water Jets and Water Drops," by Lord Rayleigh, at 9.
— Geologists' Association, 8.
— Society of Arts, 8. "Herat," by Prof. Vambéry.
Saturday, 2nd.—Royal Institution, 3. "Fir-trees and their Allies," by Mr. W. Carruthers.

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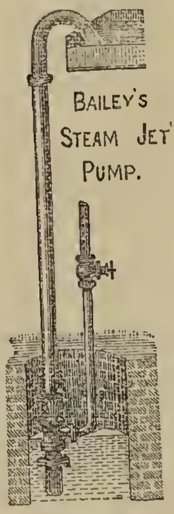

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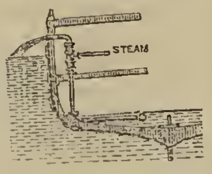

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THE CHEMICAL NEWS.

Vol. LI. No. 1327.

THE CHANGES PRODUCED IN THE ALBUMENOID MATTER OF VARIOUS SEEDS AND OF POTATOES BY STEAMING UNDER HIGH PRESSURE.

By Prof. BEHREND, of Hohenheim.

The part played by superheated water in connection with the various constituents of the raw material for the manufacture of alcohol, is to a certain extent generally well known. For instance: a considerable quantity of starch is dissolved by water at 130° C., whilst superheated steam converts fat into glycerol and fatty acids, and so on. Therefore steaming under pressure disintegrates the material and renders the condition of the starch very suitable for its subsequent conversion; a prolonged steaming is, however, detrimental, especially with material rich in fat—for example maize; first, because the destruction of fat diminishes the feeding value of the spent material; secondly, the volatile fatty acids produced must impair the quality of the alcohol; and thirdly, the antiseptic action of the fatty acids most probably exerts an unfavourable influence on the fermentation of the mash. But of all the organic constituents of a plant the albumenoids are the most readily decomposable; therefore the changes which they undergo by steaming under pressure are of great interest. If the change consists in the production of amides, then the feeding value of the spent material is lowered, but, on the other hand, amides, as nitrogenous food for the yeast during fermentation, are excellent, whilst albumenoids are inferior. Wöhler tells us that coagulated albumen and fibrin are dissolved by water at 150° C.; Lubavin shows that when albumen is digested with water for thirty-six hours at 120 to 150°, leucin and tyrosin are found among the products; in a similar manner amylamine has been obtained from casein. Heinzelmann has worked with rye and maize, and finds that the nitrogenous matter becomes soluble by prolonged heating with water at high temperature. Our knowledge, then, of these changes is but fragmentary, and good qualitative and quantitative results are wanting.

The author devotes the third part of this communication, the first two parts being the contributions to the chemistry of malting, already published in the Chemical News, vol. li., pp. 163, and 181, to the description of experiments, to the record of results obtained, and to inferences drawn from his own researches in this direction. In a preliminary experiment the author found that the albumenoids of lupin seeds underwent considerable decomposition by heating with water under pressure, and that the decomposition was greater as the duration of the heating and temperature increased. He therefore set to work to investigate whether the albumen was dissolved as well as decomposed, and if so, what the quantitative relations of these changes were in various seeds, and more especially in the raw starch material for the manufacture of alcohol. Yellow lupins, peas, Hungarian maize, dari (Sorghum tataricum), and two sorts of potatoes—(1) three-quarters of a year after harvesting; (2) freshly harvested—were experimented on. The samples are reduced to meal, rubbed through a fine sieve (480 meshes to a square c.m.), and the total nitrogen determined; this and the following analyses are done by methods as described in Part II. Then 2·5 grms. of each fine meal are boiled with 100 c.c. water, made up to 250 c.c., and 50 c.c. of filtrate taken for soluble nitrogen determination. A similar quantity is boiled with 100 c.c. water and 50 c.c. ferric acetate solution, and non-albumenoid nitrogen determined in the filtrate. Lots, of 2·5 grms. each, were put in a Lintner pressure flask with 50 c.c. of water, and heated for six hours in a paraffin bath at at 140° C., after which the several nitrogen determinations enumerated above were made. The contents of the flasks, especially when they were very starchy, became viscid and tenacious, like glue, at 70 to 100° C.; at 130° C. they were almost quite clear, limpid liquids, with just a few flocks floating about, and as the heating was continued the masses became continually darker, at first deep yellow, and then brown. The brownness being more or less intense, according as the substance was richer or poorer in nitrogen, it is hence inferred that the brown colouration is the result of the decomposition

I. *Changes produced in Nitrogenous Matter by heating with Water under Pressure.*

Percentages of the Dry Matter.

Material.	Total. Nitrogen.	Before heating under pressure.					After heating under pressure:				
		Nitrogen.		Albumenoid-Nitrogen.			Nitrogen.		Albumenoid-Nitrogen.		
		Soluble.	Non-albumenoid.	Soluble.	Insoluble.	Total.	Soluble.	Non-albumenoid.	Soluble.	Insoluble.	Total
Lupin	8·51	3·03	0·67	2·36	5·48	7·84	6·23	2·69	3·54	2·28	5·82
Pea	4·26	1·49	0·45	1·04	2·77	3·81	3·74	1·14	2·60	0·52	3·12
Maize	2·08	0·32	0·20	0·12	1·76	1·88	0·80	0·55	0·25	1·28	1·53
Dari (Sorghum tataricum)	1·40	0·15	0·13	0·02	1·25	1·27	0·64	0·43	0·21	0·76	0·97
Old potatoes (20·4 p.c. dry matter)	1·23	0·72	0·47	0·25	0·51	0·76	0·86	0·56	0·30	0·37	0·67
New potatoes (20·6 p.c. ,,)	1·43	0·76	0·58	0·18	0·67	0·85	1·02	0 60	0·42	0·41	0·83

II. *Changes produced in Nitrogenous Matter by Heating with Water under Pressure.*

Percentages of the Total Nitrogen.

Material.	Before heating under pressure.					After heating under pressure.				
	Nitrogen.		Albumenoid Nitrogen.			Nitrogen.		Albumenoid Nitrogen.		
	Soluble.	Non-albumenoid.	Soluble.	Insoluble.	Total.	Soluble.	Non-albumenoid.	Soluble.	Insoluble.	Total.
Lupin	35·6	7·9	27·7	64·4	92·1	73·2	31 6	41·6	26·8	68·4
Pea	35·0	10·6	24·4	65·0	89·4	87·8	26·8	61 0	12·2	73·2
Maize	15·4	9·6	5·8	84·6	90·4	38·5	26·4	12 1	61·5	73·6
Dari	10·7	9·3	1·4	89·3	90·7	45·7	30·7	15·0	54·3	69·3
Old potatoes	58·5	38·2	20·3	41·5	61·8	69·9	45·5	24·4	30·1	54·5
New potatoes	53·1	40·6	12·5	46·9	59·4	71·3	42·0	29·3	28·7	58·0

III. *Effect of Steaming in Henze's Pressure Boiler on the Nitrogenous Matter of Maize and Dari* (*S. tataricum*).

	Nitrogen per cent in the dry matter.						Percentages of total nitrogen.				
				Albumenoid.					Albumenoid.		
	Total.	Soluble in water.	Non-albumenoid.	Soluble.	Insol.	Total.	Soluble in water.	Non-albumenoid.	Soluble.	Insol.	Total.
Maize before steaming ..	1·86	0·26	0·21	0·05	1·60	1 65	14·0	11·3	2·7	86·0	88·7
Maize after ,, ..	,,	0·34	0·20	0·14	1·52	1·66	18·3	10·8	7·5	81·7	89·2
Dari before ,, ..	1·61	0·20	0·17	0·03	1·41	1·44	12·4	10·6	1·8	87·6	89·4
Dari after ,, ..	,,	0·31	0·22	0·09	1·30	1·39	19·3	13·7	5·6	80·7	86·3

IV. *Effect of the Duration of the Steaming on the Decomposition of Nitrogenous Matter in Lupins.*

	Nitrogen per cent in the air-dreid substanced.						Percentages of total nitrogen.				
				Albumenoid.					Albumenoid.		
	Total.	Soluble in water.	Non-albumenoid.	Soluble.	Insol.	Total.	Soluble in water.	Non-albumenoid.	Soluble.	Insol.	Total.
Not steamed	7·27	2·59	0·57	2·02	4·68	6·70	35·6	7·8	27·8	64·4	92·2
Heated to 140° C.	,,	2·58	0·72	1·86	4·69	6·55	35·5	9·9	25·6	64·5	90·1
,, at ,, for 3 hours ..	,,	4·78	1·79	2·99	2·49	5·48	65·8	24·6	41·2	34·2	75·4
,, ,, ,, ,, 6 ,, ..	,,	5·40	4·75	2·88	1·87	4·75	74·3	34·7	39·6	25·7	65·3

of nitrogenous substances. Thus, in practice, when maize mash is strongly steamed, it is dark in colour, although the temperature is much below caramelising point. When the flasks were opened there was neither pressure of gas nor odour of volatile amines. Tables I. and II. give the numerical results calculated on different bases.

The results before heating under pressure are not supposed to represent the actual state of things in the unattacked seed, as the nitrogenous matter most likely undergoes changes during analysis, or the preparations for it; but they show the state of things before the experiment, and therefore, by comparison with the results obtained at the completion of the experiment, provide the necessary data for illustrating the effect of heating with water under pressure. It will be observed that in all cases there is an increase in the soluble nitrogen, especially with lupins and peas, and whereas in the former the decomposition exceeds the dissolution of the albumenoids, in the latter the reverse is the case, and the increase in the amount of soluble albumenoids is much greater than the increase in the non-albumenoids. The nitrogenous matter of maize seems less soluble, and not so easily attacked as that of lupins and peas; it will be seen, however, that the chief difference, after the six hours heating, is in the amounts of the albumenoid dissolved; it is therefore inferred that solution of albumenoids precedes the decomposition, a supposition which is substantiated by subsequent experiment. It is, moreover, probable that the albumenoid matter of lupins and peas can better resist the action of the superheated water than can the albumenoids of maize, and in fact it is well known that these seeds do actually contain different kinds of albumenoids; lupin, conglutin; pea, legumin; and maize, fibrin; but if these are one more decomposable than the other is still a question. The acidity of lupin seeds would, of course, aid the decomposition of the albumenoids. The results with dari are similar to those with maize, whilst the results with potatoes agree, to a certain extent, with those of previous investigators; the soluble albumenoids are, however, somewhat low, owing to the author having employed potatoes dried at 100 to 110°, at which temperature the albumen naturally coagulates, and, when once coagulated, is no longer soluble in boiling water. The staleness or freshness of the potato does not influence, to any considerable extent, the action of superheated water on the nitrogenous matter, at least according to the results of these experiments.

Such changes in the nitrogenous matter as those indicated above would cause considerable loss of value in substances when exposing large bulks of material to the action of superheated water, and, as in practice the raw starch material of the distiller is, as a rule, treated in this manner at 140° C. (2½ atmospheres), the author instituted some experiments on a manufacturing scale.

Maize and sorghum were selected for experiment, and, after the various nitrogen determinations had been made, the materials were put in a Henze pressure boiler, and were gradually heated in the usual manner until steam pressure indicated 4 atmospheres; samples were taken, dried, pulverised, &c., and the various nitrogen determinations made as before. (See Table III.)

These results show that the change in the albumenoids is not nearly as great in these as in the smaller experiments. This is due to the difference in the duration of the experiment; for instance, the steaming in practice lasts about two to two and a half hours (in the above experiments it took one and a half hours to reach 140° C., and after that from thirty to forty minutes), whereas the laboratory experiments lasted 6 hours. This conclusion is confirmed by the following experiments, and these two series of experiments show that solution of albumenoids precedes their decomposition (as inferred above). These experiments were conducted in flasks in the same manner as those already described. (See Table IV.)

In practice it is therefore advisable not to prolong the period of digesting with superheated steam beyond an hour, on account of the decomposition of nitrogenous matter, as well as the other substances referred to at the commencement of this part of the present communication.

LAKMOID AND CARMINIC ACID AS REAGENTS FOR ALKALIES.

By HARRY NAPIER DRAPER, F.C.S.

Traube and Hock have recently described* the preparation, by the action of sodium nitrate upon resorcinol, of a colouring matter to which they give the provisional name of "lakmoid," which in many of its characters is remarkably like that of litmus. In working with this substance with the view of determining its relative value as an indicator, I have been at the outset so struck with its sensitiveness to alkaline reaction in the presence of carbonic acid that I wish to make a note of the fact.

The water from the river Vartry, with which Dublin is supplied, contains but 0·39 grain per gallon of calcium carbonate, while its magnesium and iron (precipitated on boiling) are, in the published analyses, stated as "traces." With this water neither the most carefully prepared neutral litmus solution nor hæmatoxylin gives the least indication of alkalinity, while the reddish solution of

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* *Berichte der Deutschen Chemischen* (see also *Chemist and Druggist*, February, 1885).

"lakmoid" produces a quite distinct blue. Dilution with ammonia-free distilled water renders the indication more distinct, doubtless by withdrawal of carbonic acid. It will be obvious that such a reagent would be valuable in the volumetric estimation of carbonates and and bi-carbonates, and I think I may venture to predict for "lakmoid" a useful future.

While I was engaged with the lakmoid experiments, my friend Professor Tichborne suggested the possibility that carminic acid might possibly be found to be equally sensitive to alkalies in the presence of free carbonic acid. The experiment was at once made, and the result was not only satisfactory but remarkable.

Carminic acid, prepared by the method of De la Rue, is not only extremely sensitive to alkalies (which change its amber-coloured dilute solution to purple-red), but the reaction is only slightly influenced by the presence of carbonic acid in saturated solution at normal pressure. In distilled water, either lakmoid or carminic acid gives a distinct reaction with sodium carbonate when but 0·05 grain of this salt is present in one gallon (one part in 1,400,000!). The change of colour is quite apparent when a beaker containing but 100 c.c. of liquid is used for the experiment, but as the impression produced upon the eye will obviously be greater if a larger beaker or a long tube be employed, this can by no means be regarded as the limit of sensibility. To most eyes the colour change of carminic acid will be more readily appreciable than that of lakmoid, and carminic acid has the important advantage that its indication is much less interfered with by the presence of free carbonic acid. But if with either lakmoid or carminic acid the alkaline solution be in presence of carbonic acid *under pressure*, the effect is very striking, and at a pressure of from three to four atmospheres the reaction is almost completely masked. The results to be obtained in this direction seem to be of quite sufficient importance to encourage further experiments, and I am therefore pursuing the subject.

Dublin, April 17, 1885.

ON THE APPLICATION OF LONGI'S METHOD FOR NITRATES TO WATER ANALYSIS.

By C. W. MOULTON.

In the Chemical News (vol. li., p. 76), appeared notice of a method proposed by Longi for the volumetric determination of nitric acid by means of diphenylamine and potassio-stannous sulphate. Desiring something more convenient and accurate than the mercury or aluminium processes for the determination of nitrates in water analysis, the writer conducted a series of experiments with a view to determining the value of Longi's method for this purpose, with the following results:—

The tin salt was prepared as directed, but of one-half the strength. Standard solutions of potassium nitrate were prepared containing 1 part of nitrogen in 100,000 and 1,000,000 parts respectively. To 5 c.c. of nitrate solution were slowly added 15 c.c. of concentrated sulphuric acid, and the whole cooled to the temperature of the room. One drop of a solution of diphenylamine in sulphuric acid concentrated was then added.

When the stronger nitrate solution was used, the colour appeared within a minute, and developed apparently to its full depth in five minutes. The weaker solution required from twenty minutes to half an hour for its full development. The tin solution was then slowly dropped in from a burette until the colour disappeared. In order to balance the errors arising from the oxidation of the stannous salt it was added in all cases in a uniform manner.

It spite of all precautions the results were very unsatisfactory. A great excess of the diphenylamine interferes with the development of the colour. Slight differences of temperature also affect it. As noted by Warington in the Chemical News (vol. li., p. 39), the oxidising power of the nitric acid decreases more rapidly than the degree of dilution. The amount of tin solution required to decolourise depended more upon the volume of the mixture of nitrate and acid to which it was added than upon the amount of nitric acid present. The same amount of nitric acid in double the volume required nearly double the amount of tin solution. For equal volumes of the mixtures of acid and nitrate solutions, the weaker solution mentioned above required nearly the same amount of tin solution as the stronger. Even using equal amounts of nitrate solution of the same strength the amount of tin solution required to decolourise is by no means uniform, six trials giving a maximum variation of 0·4 c.c. in an average of 2·4 c.c. tin solution required.

A practical difficulty arises from the fact that the process of decolourisation is quite slow. By allowing to stand an hour 1 c.c. of the tin solution will decolourise completely an amount of nitrate that would require 4 c.c., if added slowly, as above described, but continuously until the colour disappears. The proportion of which Longi speaks of 1 mol. nitrate to 4 mols. tin was in no case even approximately verified.

From these results it appears that for dilute solutions, at least, the process in question is of little value.

University of Minnesota.

ON THE METHODS OF INDIGO TESTING.

By HENRY M. RAU, Ph.D.

It appears strange, when the high price of indigo and its large consumption in the industrial arts are considered, that the methods commonly employed in this country for its valuation should, from a scientific standpoint, be so crude and inaccurate.

Taking the average price of the various grades of indigo in the market as a basis for calculation, it may be stated that a single per cent of indigotine represents, to the consumer, from two to two and one-half cents for each pound of goods purchased.

Under these circumstances it would seem highly desirable to employ tests as accurate as possible, even though these should not be as time-saving as the greater number of commercial tests.

Nevertheless, it is a fact that the ordinary indigo "analyses" are so wide of reliable results, that guess work might quite as well be substituted for them, and this in face of the fact that we have in the gravimetric determination by the reduction methods, a means for a closer valuation of indigo than can be applied in the case of almost any other dyestuff.

The ordinary mode of judging the quality of an indigo, and by which it is commonly bought and sold, is quite superficial; and even in experienced hands allows but a rude estimate of its value. The buyer or broker takes a cake of indigo, breaks it with a knife, and compares it with another of previously known worth as to colour, density, hardness, &c. Upon these points of comparison he relies for a correct valuation.

Where a formal analysis is required, the oxidation tests are usually employed; and it is to the inadequacy of these that I particularly desire to call attention. They are based upon the oxidation of the sulpho-acid of indigotine in aqueous solution by a variety of agents, with the destruction of the blue colour. The different processes in use employ potassium permanganate, potassium bichromate, bleaching-powder, or nitric acid, as the case may be. The sample of indigo is dissolved in strong sulphuric acid, and the solution brought to a certain volume by the addition of water. A measured quantity is then decolourised with an oxidising solution which has been standardised upon pure indigotine or some indigo of known value. When the blue colour of the indigotine solution has been destroyed and been replaced by a yellow or ochreous shade, the oxidation is complete and the volume of the reagent solution employed is noted. Now, if indigo contained merely the colouring principle, indigotine, in mixture with inorganic matters, this volumetric estimation would be both practical and reliable, but as its various other ingredients (which are entirely valueless) also enter into the reaction and consume a quantity of the reagent, the method gives these useless matters the same value as the indigotine. The figures obtained are, therefore, always too high, and that in no uniform ratio, but varying with the amount and character of the accompanying impurities. The colour which the latter themselves impart to the solution also renders it very difficult to determine exactly when the requisite quantity of the reagent has been added.

The reason why these methods, although known to be so faulty, have been retained in general practice, is to be found in the high figures obtained by them, which are to the apparent advantage of the dealer. Their scientific appearance also is calculated to impress the unskilled. They are, in reality, anything but scientific. A good Bengal indigo which actually contained 52·5 per cent indigotine, showed 72·5 per cent when tested by the permanganate process, a Kurpah of 41·8 per cent (with a larger proportion of organic impurities) by the same test yielded 69·2 per cent. Using potassium bichromate as the oxidising agent, the figures obtained were nearly the same. In fact, in order to achieve correct results by any of these methods, it would be necessary to determine previously the precise amount of extraneous organic matter accompanying the colouring principle.

I have recently adopted for the analysis of indigo a very convenient modification of Fritsche's reduction test, which is also sufficiently rapid to permit as many as three determinations to be made together within twenty-four hours. I proceed as follows:—From 1½ to 2 grammes of the sample, in very fine powder, are carefully weighed and placed in an 8 oz. Erlenmeyer flask (A). The flask is provided with a doubly perforated rubber stopper, through which passes a bent glass tube (B) provided with a stop-cock and reaching just below the stopper, and a second tube (C) of syphon shape which passes nearly to the bottom of the flask and terminates in a small funnel.

In this funnel is placed a wad of glass-wool. Tubes and stoppers must fit air-tight into the flask. The apparatus is accurately tared; from three to four grammes of pure grape sugar in small pieces are then placed in the flask, fifteen to twenty c.c. of a 40 per cent caustic soda solution, sixty c.c. of water, and sufficient 90 per cent alcohol (120 c.c.) to bring the whole to about seven fluid ounces, are added. The apparatus is then weighed a second time, so that by deducting the tare of the flask, &c., we obtain the weight of the total contents. A small piece of rubber tubing closed with a pinch-cock, is slipped over the syphon tube, the stop-cock is closed, and the flask heated on a water-bath for twenty-five to thirty minutes. At short intervals the stop-cock is quickly opened and closed, to relieve the pressure of the alcohol vapours, the flask being occasionally shaken. The indigo readily dissolves, the liquid assuming a deep yellow colour, the insoluble substances settling clearly to the bottom. The solution being completed, the flask is allowed to stand for about an hour, and is then connected with a generator of carbon dioxide gas.

The clear liquid is quickly run off, as far as possible, through the syphon tube, the glass wad retaining any floating particles, and the flask is again weighed quickly, whereby the weight of the liquid thus run off is ascertained. This portion is placed in a beaker glass and a stream of carbon dioxide gas passed through the same for fifteen minutes, causing the indigotine and indirubine to precipitate in crystalline flakes. A current of air is then drawn through, which completes the precipitation. The precipitate, which by this means is obtained in beautiful copper-coloured flaky crystals, is collected upon a previously dried and weighed filter, washed repeatedly with boiling water, then with hot dilute hydrochloric acid, and finally with water. Precipitate and filter are then dried at 110 degrees C., and lastly weighed. Deducting the weight of the filter, the indigotine and indirubine contained in that portion of the liquid treated as described, are obtained, and by a simple calculation the percentage contained in the whole sample is ascertained.

The advantages of this process are found in the fact that the insoluble impurities in the indigo are readily deposited, thereby avoiding the tedious filtration of the liquor, and that the indigotine and indirubine are obtained in a crystalline precipitate which is easily purified by washing.

Schunck has stated (*Lit. Phil. Soc. Man.*, xiv.) that where he employed small quantities of indigo, as compared to the quantities of alcohol, caustic soda, and grape sugar, Fritsche's process occasionally yielded him very incorrect results, the indigotine at times not precipitating at all. However this may be, the results which I have obtained by this method have been surprisingly uniform. Thus a sample of artificial indigotine, prepared from propiolic acid, tested 99·96 per cent; two analyses of pure dry indigotine from indigo showed 99·68 per cent and 99·74 per cent; three estimates of a high type Bengal indigo gave 60·35 per cent., 60·78 per cent, and 60·72 per cent.

Few analytical methods can claim greater uniformity than this.—*Journal of the American Chemical Society*.

ACCIDENTAL EXPLOSIONS PRODUCED BY NON-EXPLOSIVE LIQUIDS.*

By SIR FREDERICK ABEL, C.B., D.C.L., F.R.S.

(Concluded from p. 198).

Another fatal accident, caused by the explosion of a lamp, took place at Camberwell last January, and was brought about, as in the two preceding cases, by attempts to extinguish the lamp by blowing down the chimney. The husband and two sons of the sufferer were witnesses of this accident; the lamp had been burning for six or seven hours, when the woman took it in her hand, and having partially turned it down, pro-

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* A Lecture delivered before the Royal Institution, March 13, 1885.

ceeded to blow down the chimney; an explosion at once occurred, the glass reservoir was broken, and the inflamed oil flowed upon her dress, burning her most severely.

A lamp explosion which occurred last December, in a van used as a bedroom by an itinerant showman, at the so-called World's Fair held at the Agricultural Hall, Islington, and which caused the death of an infant, was of a somewhat different character to the foregoing. The lamp, which was of the duplex form and was attached to a bracket, had been alight for some hours, when a woman went, from a neighbouring van used as a dwelling room, to extinguish it. She observed that while the lamp, or wick, was only burning faintly, the oil in the reservoir was alight. She placed her apron over the top of the chimney to extinguish the lamp, when it at once appeared to explode, and the burning oil set the interior of the van on fire. The woman ran out for help, and a lad, protecting his head with his coat, rushed in and brought out the infant which was lying upon the bed, and which died from injuries received. The oil used in the lamp was believed to be of high flashing-point, being obtained by the retailer who supplied it, from a firm dealing in a Scotch shale oil manufactured by the Walkinshaw Company (known as an "electric light" brand). A sample of the oil, as supplied by the wholesale dealers, had a flashing-point of 114° F., but a portion of the oil actually purchased by the owner of the lamp had a flashing-point of only 63° F., and evidently consisted of a mixture of the heavy oil and of benzoline. The oil in question would naturally become exhausted of the volatile spirit after the lamp had burned for some time, and the flame would then have burned low in consequence of the heavy character of the residual oil; the lamp and its contents would have thus become highly heated, and some accidental disturbance of the surrounding air must have caused vapour generated from the heated oil and contained in the air-space of the reservoir, to become inflamed; the oil itself being thereby ignited. By placing her apron hastily upon the top of the chimney, the woman forced air into the reservoir, and thus either caused a slight explosion to take place, or determined the breaking of the glass by the sudden change of temperature. A lamp-accident, apparently due to the same cause, occurred quite recently in the cabin of a small steam-launch on the Medway, near Chatham.

Several cases of undoubted lamp explosions, fortunately unattended by serious consequences, have come to the lecturer's knowledge as having occurred in the billiard-rooms of barracks where petroleum or paraffin oil was employed as the illuminant. These lamps are fixed over the billiard tables, and generally speaking the rooms have top- or sky-lights. In every instance the lamp had been burning for several hours and had probably become more or less heated, especially as shades of sheet tin were placed over them as reflectors. In each case a portion of the glass reservoir was blown out by the explosion, and the oil, becoming ignited, burnt portions of the table on which it fell.

A careful investigation of accidents of which the foregoing are illustrations,* together with a critical examination of the construction of various lamps, and the results of many experiments, have, up to the present time, led the lecturer and Mr. Redwood to arrive at several definite conclusions with respect to the immediate causes of lamp-explosions and to certain circumstances which may tend to favour the production of such explosions.

If the lamp of which the reservoir is only partly full of oil, be carried, or rapidly moved from one place to another, so as to agitate the liquid, a mixture of vapour and air may make its escape from the lamp in close vicinity to the flame, and, by becoming ignited, determine the explosion of the mixture existing in the reservoir. This escape may occur through the burner itself, if the wick does not fit the holder properly, or through openings which exist in some lamps in the metal work, close to the burner, of sufficient size to allow flame to pass them readily. A sudden cooling of the lamp, by its exposure to a draught or by its being blown upon, may give rise to an inrush of air, thereby increasing the explosive properties of the mixture of vapour with a little air contained in the reservoir, and the flame of the lamp may at the same time be drawn or forced into the air-space filled with that mixture, especially if the flame has been turned down, as the latter is thereby brought nearer to the reservoir. The sudden cooling of the glass, if it had become heated by the burning of the lamp, may also cause it to crack if it is not well annealed, and this cracking or fracture, which may allow the oil to escape, may convey the idea that an explosion has taken place. If the evidently common practice is resorted to of blowing down the chimney with a view to extinguish the lamp, the effects above indicated as producible by a sudden cooling may be combined with the sudden forcing of the flame into the air-space, and an explosion is thus pretty certain to ensue, especially if that air-space is considerable. If the flashing-point of the oil used be below the minimum (73° Abel) fixed by law, and even if it be about that point or a little above it, vapour will be given off comparatively freely if the oil in the lamp be agitated, by carrying the latter or moving it carelessly; the escape of a mixture of vapour with a little air from the lamp, and its ignition, will take place more readily, but on the other hand it will probably be feebly explosive, because the air will have been expelled in great measure by the generation of petroleum vapour. If the flashing-point of the oil be high, the vapour will be less readily or copiously produced, under the conditions above indicated, but, as a natural consequence, the mixture of vapour and air existing in the lamp may be more violently explosive, because the proportion of the former to the latter is likely to be lower and nearer that demanded for the production of a powerfully explosive mixture. If the quantity of oil in the lamp reservoir be but small, and the air-space consequently large, the ignition of an explosive mixture produced within the lamp will obviously exert more violent effects than if there be only space for a small quantity of vapour and air, because of the lamp being comparatively full. If the wick be lowered very much, or if for some other reason the flame becomes very low, so that it is burning beneath the metal work which surrounds and projects over the wick holder, the lamp will become much heated at those parts, and the tendency to the production of an explosive mixture within the space of the lamp will be increased, while, at the same time, heat will be transmitted to the glass, and it will be correspondingly more susceptible to the effects described as being exerted by its sudden exposure to a draught. Experiments have demonstrated that a lamp containing an oil of high flashing-point is more liable to become heated than a comparatively light and volatile oil, in consequence of the much higher temperature developed by the combustion, and of the comparative slowness with which the heavy oil is conveyed by the wick to the flame. It therefore follows that safety in the use of mineral oil lamps is not to be secured simply by the employment of oils of very high flashing-point (or low volatility), and that the use of very heavy oils may even give rise to dangers which are small, if not entirely absent, with oils of comparatively low flashing-points. The occurrence of such an accident as that in the training-ship *Goliath*, already referred to, which was brought about by a boy letting fall a lamp which had been alight all night, and which was so hot that he could no longer hold it, appears to be primarily ascribable to the use of an oil of very high flashing-point; and the accident at the Agricultural Hall furnished another illustration of the kind of danger attending the use of such an oil.

The character of the wick very materially affects not only the burning quality of the lamp, but also its safety. A loosely plaited wick of long staple cotton draws up the oil to the flame regularly and freely, and so long as the oil

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* Mr. Alfred Spencer, of the Metropolitan Board of Works, has obligingly furnished me with the official details of several of the accidents above referred to.—F. A. A

be not very heavy or of very high flashing-point, and therefore difficultly volatilisable or convertible into vapour (by so-called destructive distillation), the flame will continue to burn brightly and uniformly, with but little charring effect upon the wick; that is to say, the extremity of the latter will only be darkened and eventually charred to a distance of much less than a quarter of an inch downwards, and it will not be until the partial exhaustion of the oil supply diminishes the size of the flame and induces the user to raise the wick, that the latter will become more considerably charred. But, if the wick be very tightly plaited, and made, as is not unfrequently the case, of a short staple cotton of inferior capillary power, the oil will be less copiously drawn up to the flame; as a consequence, the length of exposed wick will be increased by the user of the lamp, and as the evaporation of the oil will take place more slowly from each portion of the wick which furnishes the flame, the heat to which the cotton is exposed will be greater, and the charring, which is fatal to the proper feeding of the flame by destroying the porosity of the end of the wick, will take place more rapidly and to a much greater extent.

Even with wicks of the higher qualities, considerable differences exist in the rapidity with which the oil is raised to the flame. In Mr. Redwood's experiments, conducted with a specimen of English wick of good quality and with a very superior American wick, of corresponding dimensions, the quantity of oil syphoned over by the latter in a given time, was from 35 to 47 per cent greater (according to the nature of oil experimented with) than that carried over by the English wick.

If the wick be at all damp when taken into use, its power of conveying the oil to the flame will be decidedly diminished, the capillaries of the fibre being more or less filled with moisture, and similarly, if the oil accidentally contain any water, the latter, passing into the wick, will interfere with the proper feeding of the flame. As the oil is very thoroughly filtered or strained during its transmission through the body of the wick to the flame, it is obvious that any impurities suspended in the liquid will be deposited within the wick and will gradually diminish its porosity. For this reason the same wick should not be used for a great length of time, and it is decidedly objectionable to use a much greater length of wick than is necessary to reach to the bottom of the reservoir, and to continue its use until it has become too greatly shortened by successive trimmings. On the other hand, the wick should always be of sufficient length to be immersed to a considerable distance in the oil. It is evident that the copious supply of oil to the flame will become reduced as the column of liquid which covers the wick in the reservoir becomes reduced in height; hence the supply of oil in the lamp should never be allowed to get very low, not only because it is undesirable to have a large air-space which may be filled with vapour and air, but also because the burning of the lamp is injuriously affected thereby.

Some lamps, of patterns first constructed in the United States, are provided with what may be called a feeding wick in addition to the wick, or wicks, which furnish the flame. This wick is generally simply suspended from the lower surface of the burner, and reaches nearly to the bottom of the reservoir, being so placed that it hangs against one flat side of the regular wick, and thus aids considerably the copious and uniform absorption of oil by the latter. In certain lamps of recent construction the reservoir which contains the main supply of oil is so arranged (upon the principle of the old study or Queen's oil-lamp), that it regularly maintains at a uniform level the supply of oil, which surrounds the wick in a small central reservoir or cylinder, separated from the main reservoir (excepting as regards a small channel of communication) by an air-space, which presents the additional advantage of preventing the transmission of heat to the oil-vessel. This kind of lamp is constructed entirely of metal; this is the case now with a very large proportion of the lamps in use, and unquestionably adds greatly to the safety of lamps, which, if constructed of glass or porcelain, are always liable to accidental fracture, quite apart from the question of possible explosion.

It has been proved experimentally that if the reservoir of a burning lamp be warmed, so as to favour the emission of vapour into the space above the oil, and a small opening in the top of the reservoir be then uncovered, air will be drawn into the latter and form an explosive mixture with the vapour, which, escaping from the lamp close to the wick-holder, will be fired and produce an explosion in the lamp. It is an interesting illustration of the very imperfect appreciation, by some lamp designers, of the conditions which, in the construction of a lamp, secure safety or determine danger, that the reservoirs of some petroleum lamps are actually furnished with an opening in the upper surface, which is closed with a more or less badly fitting metal cap, and is intended to be used for filling the lamp with oil. Independently of the great element of danger which this fitment presents, in consequence of the obvious temptation to the users to replenish the reservoir while the lamp is actually burning, it is very likely sooner or later to be the means of admitting to the reservoir, in the manner above indicated, the supply of air necessary to determine the explosion of vapour therein existing.

Another source of danger introduced in the construction of lamps which should be sufficiently obvious, and to which reference was made when first discussing the causes of lamp explosions, consists in the provision in many lamps of openings of considerable size close to the burner, apparently with the object of affording a passage for the air, or vapour, in the reservoir which may expand as the lamp becomes somewhat warm. Other devices with the same object in view, consisting of small channels or shafts brought up from the top of the reservoir to the seat of the lamp flame, are adopted in some American lamps. If these openings or channels were protected, in accordance with the well-known principles which govern the construction of miners' safety lamps, so as to preclude the possibility of flame passing them, they would obviously be unobjectionable, and, indeed, in one or two instances of modern lamps the openings which have been provided for the escape of expanding air or vapour are of such dimensions that flame could not pass. A simple arrangement which would effect the desired object with perfect safety, and would at the same time protect the lamp wicks from deterioration by the grosser impurities sometimes contained in portions of a supply of oil, is to attach to the bottom of the burner a cylinder of wire gauze of the requisite fineness (28 meshes to the inch) which would contain the wicks, and would allow the passage of air or vapour through it towards the burner, while it would effectually prevent the transmission of fire from the lamp flame to the air-space of the reservoir.

Some of the more prominent points elicited by the inquiry in progress, as to the causes of explosions in petroleum lamps, and the conditions which regulate their efficiency and safety, having now been noticed, it remains to offer a few simple suggestions, the attention to which cannot but serve to reduce the risks of accident which attend the use of petroleum and paraffin oil.

1. It is desirable that the reservoir of the lamp should be of metal. It should have no opening or feeding place in the reservoir, nor should there be any opening or channel of communication to the reservoir at or near the burner, unless protected by fine wire gauze, or packed with wire, or unless it is of a diameter not exceeding 0·04 inch.

2. The wick used should be of soft texture and loosely plaited; it should fill the entire space of the wick-holder, and should not be so broad as to be compressed within the latter; it should always be thoroughly dried before the fire, when required for use. The fresh wick or wicks should be but little longer than sufficient to reach to the bottom of the reservoir, and should never be immersed to a less depth than about one-third the total depth of the reservoir.

3. The reservoir or lamp should always be almost filled before use.

4. If it be desired to lower the flame of the lamp for a time this should be carefully done, so as not to lower it beneath the metal-work deeper than is absolutely necessary; but it should be borne in mind that even then the combustion of the oil will be imperfect, and that vapour of unconsumed petroleum will escape and render the lamp very unpleasant in a room.

5. When the lamp is to be extinguished, and is not provided with an extinguishing arrangement (of which many excellent forms are now applied to lamps), the flame should be lowered until there is only a flicker; the mouth should then be brought to a level with the top of the chimney, and a sharp puff of breath should be projected *across* the opening. The lamp should remain on a firm support when it is being extinguished.

The lecturer hopes that, pending the more thorough treatment of this subject by Mr. Redwood and himself when these investigations are completed, the points dealt with in this discourse which relate to accidents with petroleum lamps may, on the one hand, tend to dispel groundless alarm as to the dangerous nature of petroleum and paraffin oil as illuminants, and may, on the other hand, serve to convey some useful information respecting the causes which lead to accidents with lamps and the readiness with which they may be avoided.

A CATALOGUE OF CHEMICAL PERIODICALS.*

By H. CARRINGTON BOLTON, Ph.D.,
Professor of Chemistry in Trinity College, Hartford, Conn.

(Continued from p. 195).

Explanation of Signs.

+ Following a date signifies current at the date in question.
‖ Following a date signifies publication discontinued.

21. Annals of Pharmacy and Practical Chemistry. Edited by W. Bastick and W. Dickenson. 3 vols., 8vo. London, 1852-'54. ‖

22. Annals of Philosophy; or Magazine of Chemistry, Mineralogy, Mechanics, Natural History, Agriculture, and the Arts. By Thomas Thomson. 16 vols., 8vo. London, 1813-'20.

New series. [Edited by Richard Phillips.] 12 vols., 8vo. London, 1821-'26.

United in 1827 *with the* Philosophical Magazine and Journal. *See* Philosophical Magazine.

23. Annuaire des Produits Chimiques, de la droguerie et de l'épicerie en gros, contenant la liste complète des fabricants, &c., de France, de l'Italie, de Belgique, et de la Suisse. 4 vols., 8vo. Paris, 1874-78.

24. Annuaire de Chimie, comprenant les applications de cette science à la médicine et à la pharmacie, ou répertoire des découvertes et des nouveaux travaux en chimie faits dans les diverses parties de l'Europe, par E. Millon et J. Reiset, avec la collaboration de F. Hoefer et de Nicklès. 7 vols., 8vo. Paris, 1845-'51. ‖

Annuaire de Chimie - - - par Laurent et Gerhardt. *See* Comptes Rendus mensuels des travaux chimiques, &c.

25. Annuaire des Sciences Chimiques, ou Rapport sur les progrès des sciences naturelles présenté à l'académie de Stokolm [*sic*]. Par Berzelius. Supplément à son Traité de chimie. Traduit en Français par H. D. 8vo. Paris, 1837.

See Rapport annuel sur les progrès des sciences; *also* Årsberättelse om Framstegen i Fysik och Kemi.

26. Annual Report of the Progress of Chemistry and the allied sciences, physics, mineralogy, and geology; including the application of chemistry to pharmacy, the arts, and manufactures. By Justus Liebig and H. Kopp with the co-operation of H. Buff, Frederick Knapp, Ernest Dieffenbach, Charles Ettling, Henry Will, Frederick Zamminer. Edited by A. W. Hofmann and Warren de la Rue. 1847-'53. 7 vols., 8vo. London, 1849-'55.

See Jahresbericht über die Fortschritte der reinen - - - Chemie. Giessen.

27. Annuario Almanacco pei Chimici, Farmacisti, e Medici Italiani, redatto per cura del farmacista Ign. Cugusi-Persi da Cagliari. 5 vols., 16mo. Milano, 1874-'79.

28. Annuario Chimico Italiano dell'anno 1845, diretto da Francesco Selmi e compilato dal medesimo in compagnia dei Signori Giuseppi Parmeggiani e Giovanni Giorgini. 1 vol., 8vo. Modena, 1846.

29. Annuario delle Scienze Chimiche e Naturali 1 vol,, 8vo. Verona, 1840.

30. Annuario delle Scienzi Chimiche, Farmaceutiche, e Medico-legali ad uso dei farmacisti e medici, in continuazione del Supplimento al trattrato di farmacia, del Sign. Virey; della Gazzetta eclettica di farmacia e chimica. 1 vol., 8vo. Mantova, 1840.

Continued under the title:

[a] Annuario delle scienze chimiche, farmaceutiche, e medico-legali, contenente tutte le scoperte relative a queste scienze, la relazione di lavori chimici e naturali, delle riunioni degli scienziati italiani e stranieri, di quelli particolari di J. J. Berzelius, e la traduzione della chimica organica di J. Liebig. Redattore G. B. Sembenini. 9 vols., 8vo. Mantova, 1841-'49.

Cf. Gazzetta eclettica di farmacia e chimica.

31. Anti-Adulteration Review. — vols. London, 1871-'80. +

32. Archiv der Agriculturchemie für denkende Landwirthe. Herausgegeben von Sig. F. Hermbstädt. 7 vols., 8vo. Berlin, 1803-'18. ‖

33. Archiv for Pharmaci, redigeret af S. M. Trier. 3 vols., 8vo. Kjobenhavn, 1844-46.

Continued under the title:

[a] Archiv for Pharmaci og technisk Chemi med deres Grundvidenskaber. Redigeret af S. M. Trier. Det technisk-chemiske Afsnit redigeret af P. Faber. 34 vols. (iv.-xxxvii.), 8vo. Kjobenhavn, 1847-'80. +

Index. Vols. i.-xv., 1844-'58. Kjobenhavn, 1859.

34. Archiv für die Gesammte Naturlehre. In Verbindung mit Bischoff, Förstmann, C. G. Gmelin, Grischow, F. W. von Paula Gruithuisen, Hallaschka, Pl. Heinrich, A. von Humboldt, John, Kleefeldt, Lichtenberg, Marx, Olbers, Pleischl, Prechtl, Schmidt, Schön, Späth, Wollner, und Zimmerman, herausgegeben von C. W. G. Kastner. 27 vols., 8vo. Nürnberg, 1824-'35.

Vols. xix.-xxvii. *also under the title:*

Archiv für Chemie und Meteorologie, in Verbindung mit mehreren Gelehrten, herausgegeben von C. W. G. Kastner. 9 vols. (i.-ix.), 8vo. Nürnberg, 1830-'35.

(To be continued).

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* Advance-proofs from the *Annals of the New York Academy of Sciences*

PROCEEDINGS OF SOCIETIES.

PHYSICAL SOCIETY.

April 25th, 1885.

Prof. Guthrie, President, in the Chair.

The following papers were read:—

"*On the Theory of Illumination in a Fog*," by Lord Rayleigh. The paper dealt with certain theoretical results based upon the assumption that the medium in which the fog was formed, and the substance composing the fog itself, were perfectly transparent. The effect of such a fog surrounding a source of radiation would be to diminish the radiation, and in the case of a supply of energy from without, as with the carbon filament of an incandescent lamp, the temperature of the source would be increased by the fog. A spherical envelope of such a fog surrounding the lamp, and sufficiently thick to be impervious, would act as a perfectly reflecting surface. A problem closely related to the above, and which is easily worked out, is that of light incident normally upon a pile of glass plates. If m be the number of such plates, and ρ the fraction of incident light reflected by one plate, $\phi(m)$ the light reflected, and $\psi(m)$ that transmitted by a pile of m plates, we have—

$$\frac{\phi(m)}{2m\rho} = \frac{1}{1+(2m-1)\rho} = \frac{\psi(m)}{1-\rho}$$

If the transmitted light be allowed to fall upon another pile consisting of n plates we have an infinite amount of reflection between the plates, and as the final result, if A denotes the radiation in the original direction, and B that in the opposite—

$$A = \frac{2n\rho + 1 - \rho}{2(m+n)\rho} \qquad B = \frac{2n\rho}{2(m+n)\rho+1}$$

If m and n are large we have $A = B = \dfrac{n}{m+n}$ which shows that, by increasing n we can make the radiation between the plates as much as if the first pile did not exist, whatever the number of plates in it.

"*On a Monochromatic Telescope*," by Lord Rayleigh. This is a modification of Maxwell's colour-box. In this instrument, as is well known, light passes through a slit in the focus of a collimating lens, it traverses in succession this lens, a prism, and another lens, by which it is brought to a focus upon a plane surface in which is a movable slit, the eye being placed behind which receives light approximately monochromatic. If, in addition, a lens be placed just behind the first slit, so as to bring some distant object into focus at a convenient distance from the eye, this object will be seen by the light that would enter the eye in the simple colour-box. The author suggested the use of this instrument to compare lights of different colours, and hinted at the possibility of choosing some colour towards the middle of the spectrum at which lights might be compared for practical purposes.

"*On the Self-Regulation of the Compound Dynamo*," by Professor A. W. Rücker. If ϕ represents the current or electromotive force in the external circuit of either form of compound dynamo it is given by means of an equation of the form

$$\phi = \frac{P}{A+x} - \frac{Q}{B+x}$$

where A, B, P, and Q are quantities which are different in different cases, but are always independent of the external resistance, and x is the conductivity or the resistance of the external circuit, according as ϕ represents the E.M.F., or current. The constant A in all cases depends only on the resistance of the various parts of the machine. If μ and m are respectively the largest and smallest values of x, between which self-regulation is aimed at, then $\mu - m$ may be called the *range of x*. That value of x which corresponds to the resistance most frequently used may be called the *usual value* of x, and indicated by ξ.

The maximum efficiency, η, of the machine is connected with A and ξ by the relations.

$$A = \xi\,(1-\eta)/(1-\eta) \text{ if } \phi \text{ be the external E.M.F.}$$
$$A = \xi\,(1-\eta)/(1+\eta) \text{ if } \phi \text{ be the external current.}$$

It can easily be shown that the function ϕ has two critical values, and that the value of x corresponding to one of these is necessarily negative, unless one of the inducing spirals is wound so as to diminish the magnetisation. Various cases are considered corresponding to different relations among the magnitudes of the constants A, B, P, and Q. The following indications of the method of treatment may suffice. If $A/B < 1 < \sqrt{P}/\sqrt{Q}$, ϕ is positive for all positive values of x, and the critical value of ϕ occurs for a negative value of x, so that ϕ diminishes as x increases. Hence if we write—

$$\frac{P}{A+m} + \frac{Q}{B+m} = \phi,$$

we must have—

$$\frac{P}{A+\mu} - \frac{Q}{B+\mu} = \frac{\phi_1}{1+q},$$

where q is a positive quantity, which will be less as the self-regulation is more perfect. These equations give—

$$P = \frac{\phi_1}{1+q} \cdot \frac{\mu - m - q(B+m)}{(A-B)(\mu - m)}(A+\mu)(A+m).$$

$$Q = \frac{\phi_1}{1+q} \cdot \frac{\mu - m - q(A+m)}{(A-B)(\mu - m)}(B+\mu)(B+m).$$

Now since $A-B$ is negative we must if P and Q are positive, have $q > (\mu - m)/(A+m)$ and *à fortiori*—

$$q > (\mu - m)/(B+m).$$

By similar methods inferior limits to q are found in other cases, and it is thus shown that for given values of μ and m the limit is lower as A is larger. It has, however, been proved above that if the maximum efficiency of the machine is high, A will be large or small according as it is taken from an expression that gives the external E.M.F., or the external current. Hence it is more difficult to combine high efficiency with good self-regulation, if an approximately constant external current is desired, than if an approximately constant external E. M. F. is aimed at. The equations do not lead to any simple rules for the relations which should hold between the various parts of compound dynamos, but if some of the constants are taken as given, the values which must be assigned to the others can be calculated if a given efficiency for the usual value of x, and a given deviation from perfect self-regulation between given values of x, are to be attained.

"*On the Determination of the Heat-capacity of a Thermometer*," by Mr. J. W. Clarke. The method consists in the estimation of the masses of the mercury and glass of the thermometer immersed by weighing the instrument in air and in water, and again in water when immersed to the extent usual in the thermal experiment. The specific gravity of the glass and mercury being known, the absolute masses immersed can be readily calculated, and, consequently, their thermal capacity.

A photometer which enabled a comparison to be made between the light of a lamp emitted at any angle and a standard was exhibited by Mr. Dibdin, and the action explained by Mr. Livingstone, who stated that the maximum amount of illnmination took place at an angle of 45°.

CORRESPONDENCE.

MYSTERY GOLD.

To the Editor of the Chemical News.

Sir,—At the present time a considerable amount of jewellery made of this alloy is believed to be manufactured; chiefly with the object of defrauding pawnbrokers to whom it is offered in pledge, and as it will stand the usual jeweller's test of strong nitric acid, the fraud is often successful. The article examined was a bracelet that had been sold as gold to a gentleman in Liverpool.

The alloy, after the gilding had been scraped off had about the colour of 9 carat gold. Qualitative analysis proved it to consist of platinum, copper, and a little silver; and quantitatively it yielded the following results:—

Silver	2·48
Platinum	32·02
Copper (by difference)	65·50
	100·00

Strong boiling nitric acid had apparently no action on it, even when left in the acid for some time.—I am, &c.,

W. F. Lowe, Assoc. R.S.M.

Assay Office, Chester.

ACTION OF SULPHURIC ACID UPON FERROUS SULPHATE.

To the Editor of the Chemical News.

Sir,—In the Chemical News (vol. li., p. 193) I was surprised to see that the reaction of the above-mentioned bodies is described by Dr. Divers and Mr. Shimidzu as "a fact which appears to be but little if at all known." So far is this from being the case that it is the usual method employed for preparing ferric sulphate on the large scale, and I have myself made some tons of this salt in this way. The reaction was described by Mr. Peter Hart, of Manchester, in the *Chemical Gazette* for September 15, 1854, page 350; he gives:—

$$2(FeOSO_3)+2SO_3=Fe_2O_3,3SO_3+SO_2.$$

—I am, &c.,

Wm. B. Giles.

100, Warton Road, Stratford, E.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

Note.—All degrees of temperature are Centigrade unless otherwise expressed.

Comptes Rendus Hebdomadaires des Séances, de l'Académie des Sciences. Vol. c., No. 15, April 13, 1885.

Phenomena Presented by Permanent Gases Evaporating in a Vacuum, on the Limit of the Use of the Hydrogen Thermometer, and on the Temperature obtained by the Release of Liquefied Hydrogen.—S. Wroblewski.—It is clear that, at the temperature where hydrogen no longer follows the laws of Gay-Lussac and Mariotte, the use of the hydrogen thermometer is illusory. A thermo-electric battery, calibrated between +100° and −130°, is a complete substitute for the hydrogen thermometer between +100° and −193°. Below −193° the thermometer indicates lower temperatures than the battery; that is, hydrogen below this temperature contracts more than the laws of Mariotte and Gay-Lussac require. The error is so much the greater as the temperature falls. Thus the solidification points of carbon monoxide and of nitrogen have been given in the *Comptes Rendus* as −207° and −214°. The battery indicates for the former of these temperatures −199° and for the latter −203°. Thus all the numbers relating to the evaporation of permanent gases in a vacuum which have been published in the *Comptes Rendus* are below the reality. For atmospheric air its laws of liquefaction are not those of a simple gas, as it has been asserted. Air behaves like a mixture, the components of which are subject to different laws of liquefaction. Hydrogen submitted to a pressure of 180 to 190 atmospheres, cooled by means of nitrogen boiling in a vacuum (at its solidification point), and suddenly released under atmospheric pressure, presents a very visible fog. In this fog the author has obtained with his thermo-electric battery temperatures of −208° to −211°.

New Arrangement of the Thermo-Electric Battery.—MM. Clamond and J. Carpentier.—The elements of which this battery is formed are plates of iron or nickel and bars of an alloy of antimony and zinc. This alloy gives its maximum of thermo-electric power when the two metals are mixed in equivalent proportions. Slight departures from these proportions involve great losses in the energy of the elements. Each element attains its maximum of electromotive force at the temperature of fusion. This maximum is one-tenth volt for the iron-alloy elements, and one-eighth for the nickel-alloy elements.

On a Battery with Two Liquids.—A. Dupré.—The author succeeds in suppressing the nitrous vapours of the Bunsen battery by using a depolarising liquid, consisting of nitric acid in which 75 grms. potassium dichromate have been dissolved per litre. In contact with the zinc he employs either acidulated water or potassium disulphate.

On the Copper Oxides.—M. Joannis.—A thermochemical paper, in which the author seeks to demonstrate that the bodies obtained by fusing the two oxides, and which present, according to the temperature, variable compositions, are merely mixtures, and not true compounds.

Attraction exerted between Bodies in Solution and Solids Immersed.—J. Thoulet.—The author lays down the three following propositions:—There is an attraction between a body in solution and a solid immersed in such solution. This attraction is exerted instantaneously. All other things being equal, the attraction is directly proportionate to the surface of the immersed solid.

Preparation of Cyanogen by the Moist Way.—G. Jacquemin.—The author puts in a retort, set in the water-bath, 2 parts copper sulphate dissolved in 4 parts of water, and he adds at intervals—by means of a funnel with a ground glass tap—a solution containing 1 part of pure potassium cyanide. The reaction begins briskly at the common temperature, and when it slackens the water-bath is heated. From 10 grms. of pure potassium cyanide the author obtains 850 c.c. of pure cyanogen.

Determination of Cyanogen Mixed with other Gases.—G. Jacquemin.—In gas-analyses the author removes cyanogen by means of aniline, which absorbs it rapidly, whilst it does not absorb any appreciable quantity of carbon dioxide, carbon monoxide, or atmospheric air, even if left in contact for twenty-four hours.

Primary Haloid Derivatives of Ordinary Ether.—L. Henry.—An examination of mono-iodic, mono-bromic, and mono-chloric ethers.

New Contribution to the Question of Boric Acid of a Non-Volcanic Origin.—M. Dieulafait.—Boric acid has not always a volcanic origin. It exists in enormous quantities in salt lakes whose elements are all of a sedimentary origin, and which have been formed by the evaporation of normal sea-waters.

Journal für Praktische Chemie.

New Series, Vol. xxxi., Nos. 2 and 3.

Contributions to the Chemistry of the Cobalt-Ammonium Compounds. IV. Roseo-Cobaltic Salts.—S. M. Jörgensen.—The author distinguishes the roseo-cobaltic from the purpureo-cobaltic salts. The latter are characterised by the circumstance that they contain two equivalents of an electro-negative radicle in especial combination. The roseo-salts do not display this behaviour, but they contain 2 mols. constitutional water which they cannot lose without passing into purpureo-salts. They may be regarded as luteo-salts containing $2OH_2$ instead of $2NH_3$. The author then examines in detail the principal roseo-cobalt compounds.

On Thio-Phosphoric Acids.—Dr. C. Kubierschky.—The author refers to the imperfect state of our knowledge concerning the thio-acids and salts, and still more concerning such acids and salts whose oxygen is replaced in part only by sulphur. He examines mono-, di-, and tri-phosphoric acids and their salts, though he has not yet obtained the last-mentioned class in a state of purity. All the thio-phosphates are readily decomposed by acids with evolution of hydrogen sulphide, and a partial liberation of sulphur. The mono-thio-phosphates give, with the soluble salts of calcium, barium, and strontium, white voluminous precipitates: the di-phosphates give white silky precipitates with salts of barium and strontium only, and the tri-thio-phosphates with barium only. With salts of cadmium, copper, silver, and mercury (mercurous), all the thio-sulphates give precipitates which are coloured, except those of cadmium. These decompose on standing, yielding the corresponding sulphide. The author further describes and figures the spectral reactions of several of the thio-phosphates.

On Kyanmethethine.—C. Riess and E. v. Meyer.—The authors examine the behaviour of sodium with a mixture of cyanethyl and cyanmethyl. Among the products was kyanmethethine, $C_8H_{13}N_3$, a compound which melts at 165° to 166°, and crystallises from benzol in well-developed rhombic leaflets, which begin to sublime even below 100°. They dissolve readily in alcohol, less readily in benzol and ether.

Apparatus for Chemical Laboratories.—Dr. Joh. Walter.

Hand Regulator for the Electric Light for the Projection of Spectra.—The arrangement cannot be intelligibly described without the four accompanying figures.

On Phenyl Cyanite.—Fr. Gumpert.—The author examines whether the secondary and tertiary alcohols unite directly with phenyl cyanate to form urethanes, as do methylic, ethylic, and amylic alcohol.

On Paramethyl-isatic Acid and its Derivatives.—W. Panatović.—This acid dissolves sparingly in water, more readily in boiling alcohol, and especially in acetone, from which it crystallises in small rhombic columns. At 245° it is decomposed with a sudden increase of volume, and melts at 300° with escape of carbonic acid. It is much more stable than isatic acid.

On Certain Derivatives of Ortho-amido-Benzamide.—A. Weddige.—An examination of acetyl-ortho-amido-benzamide and anhydro-acetyl-ortho-amido-benzamide.

On the Haloid Substitution-products of Propionic Acid.—L. Henry.—From the *Comptes Rendus.*

Biedermann's Central Blatt fur Agrikultur Chemie.

Vol. xiii., Part 9.

Atmospheric Electricity.—L. Palmieri.

Observations on Atmospheric Electricity.—W. Dufour.—This observer places the daily maxima at 7 a.m. and 9 p.m., and the minima at 3.5 p.m. and 3.4 a.m. To be noted is the low value of the atmospheric potentia between midnight and 5 a.m., and its rapid increase from 5 to 7 a.m.

Influence of the Soil and of Cultivation upon Temperature and Moisture of the Atmosphere.—E. Wollny.—It appears from the author's experiments: (1.) That the air is considerably cooler over a field under crop than over a fallow field. (2.) That the fluctuations of temperature in the former case are smaller than in the latter. The maximum of atmospheric temperature travels with the course of the sun, from eastern declivities in the morning to the southern at noon and to the western in the evening.

Observations on the Influence of the Weather on the Life-time and the Mode of Vegetation of Plants.—F. Hildebrand.—The author made his observations in the year 1882. In that season there was in the beginning of summer dry heat; then prolonged rains and low temperature, and finally an absence of frost until very late in the year. In and after the rains many plants put forth shoots which would otherwise have remained dormant until the next spring. Many seeds of annual plants germinated in the autumn and matured flowers and even seed.

Influence of Weather upon the Harvest.—C. Ferrari.—Observations made in Italy. It was observed that for wheat and barley the harvest was the poorer the more cloudiness from March to June, the greater the number of rainy days in spring, and the lower the temperature from April to June. For vines it was found that if the mean temperature of two winter months approaches −4° the crop is 75 per cent below the average, and if it approaches −2° 50 per cent. For southern fruits generally the colder the winter the poorer is the crop.

Depth of Arable Soil and its Dependence on General Agricultural Relations.—Professor Heinrich.—The author draws the following conclusions:—The nourishment of plants ensues best when the plant-food in the soil or water reaches a certain concentration. Hence not the absolute quantity of plant-food, but its concentration determines the fertility of a soil. Deep tillage without a simultaneously increased application of manure is hurtful, since the plant-food is thus diluted and the nutrition of the crop rendered more difficult. Deep tillage ensures, but heightened concentration of plant-food increases, the harvest.

Researches on the Utilisation of Night-soil Disinfected with Carbolic Acid as Manure.—S. Saraki, J. Savano, and O. Kellner.—The experiments in question were made in Japan during the cholera epidemic of 1882. Top-dressings with carbolated night-soil were found injurious only in case of young wheat plants.

The Action of Soluble and Insoluble Phosphates.—Dr. A. Voelcker.—From the *Journal of the Royal Agricultural Society.*

On Fine and Coarse Superphosphate.—Prof. F. Farsky.—In the majority of cases a fine superphosphate acts better than a coarse-grained kind.

The Action of Superphosphates.—P. P. Dehérain.—From the *Comptes Rendus.*

The Uninterrupted Growth of Wheat and Barley at Woburn.—Dr. A. Voelcker.—From the *Journal of the Royal Agricultural Society.*

MISCELLANEOUS.

Fusion of Iridium.—We are favoured with a very long letter from Mr. Nelson W. Perry, E.M., Cincinnati, in reply to a letter published in the Chemical News, (vol. li., p. 76), from Messrs. Johnson, Matthey, and Co., in which these gentlemen called in question the justice of Mr. Perry in his article on "Iridium" (Chem. News, vol. li.,

p. 1), accrediting the discovery of the fusion of this element by phosphorus to Mr. John Holland. Mr. Perry takes exception to the statement of Messrs. Johnson, Matthey and Co., that in the Great Exhibition of 1851 they exhibited "a large piece of iridium alloy similar to that patented by Mr. Holland, and that the ready fusion of iridium with phosphorus was a matter of metallurgical knowledge long before such exhibit." Mr. Perry has been unable to find any reference in his search through the literature bearing on iridium to this fact of fusibility, and in his letter to us he gives some of the correspondence that took place between Mr. Holland and Messrs. Johnson, Matthey, and Co., with regard to the possibility of obtaining a supply of iridium suitable for the McKinnon pen-points. Samples of this metal which Messrs. Johnson, Matthey, and Co., forwarded to Mr. Holland, it is stated, were not found to be of a texture quite suitable for the purposes intended, and Mr. Perry seems to conclude from the differences between these samples of iridium and the material obtained by Mr. Holland's process that the use of phosphorus is in reality new. It does not seem to us, however, that the conclusion Mr. Perry would draw is quite justified by these facts, and that the samples of iridium submitted by Messrs. Johnson, Matthey, and Co., had not been fused by the aid of phosphorus, or indeed that the fact of fusibility under such circumstances had not been known and practised for many years. That such a method for fusing iridium was a matter of metallurgical knowledge to a limited few is possible, and it seems to us that such knowledge on the part of the principal workers in this metal would not be likely to become publicly known.

MEETINGS FOR THE WEEK

Monday, 4th.—Medical, 8.30.
—— Society of Arts, 8. (Cantor Lectures). "The Manufacture of Toilet Soaps," Dr. C. R. Wright, F.R.S.
—— Royal Institution, 5. General Monthly Meeting.
— Society of Chemical Industry, 8. "Strength of Aqueous Solutions of Sulphurous Acid," by Messrs. Giles and Shearer." Discussion on Prof. Munro's Paper on "The Manurial Value of Filter-pressed Sewage Sludge."
Tuesday, 5th.—Institution of Civil Engineers, 8.
—— Pathological, 8.30.
—— Royal Institution, 3. "Digestion and Nutrition," by Prof. Gamgee.
Wednesday, 6th.—Society of Arts, 8. "Nobert's Ruling Machine," J. Mayall, jun.
Thursday, 7th.—Royal Institution, 3. "Natural Forces and Energies," by Prof. Tyndall.
—— Royal, 4.30.
—— Royal Society Club, 6.30.
—— University College Chemical and Physical Society. "Induction in Metallic Masses," by A. H. Fison, D.Sc.
—— Chemical, 8. Ballot for the Election of Fellows (important). "On the Action of the Copper-Zinc Couple on Organic Bodies. Part X.—Benzine Bromide," by Dr. J. H. Gladstone, F.R.S., and Mr. Tribe. "Researches on the Relation between the Molecular Structure of Carbon Compounds and their Absorption Spectra," by Prof. W. N. Hartley, F.R.S. "On some Points in the Composition of Soils; with results illustrating the Sources of fertility of Manitoba Prairie Soils," by Sir J. B. Lawes, F.R.S., and Prof. J. H. Gilbert, F.R.S.
Friday, 8th.—Royal Institution. 8. "On Adaptation to Surroundings as a Factor in Animal Development," by W. F. R. Weldon, at 9.
—— Astronomical, 3.
—— Quekett Club, 8.
—— Society of Arts, 8. "The Ancient and Modern Methods of Treating Epidemics of Small-pox in India," by Robert Pringle.
Saturday, 9th.—Physical, 3. (Meeting at Bristol.) "On Evaporation and Dissociation," by Prof. W. Ramsay and Dr. S. Young. "On a Self-recording Stress and Strain Indicator," by Prof. H. S. H. Shaw. "On a Model illustrating the Propagation of the Electro-magnetic Wave," and "On a New Curve Writer," by Prof. S. P. Thompson, D.Sc. "Note on the so-called Silent Discharge of Ozone Generators, by Mr. W. A. Shenstone.
—— Royal Institution, 3. "Fir-trees and their Allies," by Mr. W. Carruthers.

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THE CHEMICAL NEWS.

Vol. LI. No. 1328.

ARTIFICIAL ASBESTOS, OR FRENCH CHALK, FOR PACKING AND CLOSING LEAKAGES.

By L. C. LEVOIR,
Professor of Applied Chemistry, Technical School, Delft.

The mineral asbestos is but a very poor packing material in steam-boilers. Moreover, it acts as a strong grinding material on all moving parts.

For some years I have tested the applicability of artificial precipitates to close the holes in boilers, cylinder-covers, and stuffing boxes. I took, generally with the best success, alternate layers of hemp-cotton, thread, and absorbent paper, all well saturated with the chlorides of calcium and magnesium. The next layers of the same fibre are moistened with silicate of soda. By pressure the fluids are mixed and the pores are closed. A stuffing box filled with this mixture has worked three years without grinding the piston-rod.

In the same manner I close the screw-thread hole in gas tubes used for conducting steam. I moisten the thread in the sockets with oleic acid from the candle-works, and dust over it a mixture of 1 part of minium,' 2 parts of quick-lime, and 1 part of linseed powder (without the oil). When the tube is screwed in the socket the powder mixes with the oleic acid. The water coming in at first makes the linseed powder viscid. Later the steam forming the oleate of lime and the oleate of lead, on its way to the outer air, presses it in the holes and closes them perfectly.

After a year in use the tubes can be unscrewed with ease, and the screw-threads are perfectly smooth.

With this kind of packing only one exception must be made—that is, it is only tight under pressure; condensation or vacuum must be thoroughly avoided.

CRITICAL REMARKS
ON THE
METHODS FOR FIXING COLOURING-MATTERS UPON COTTON BY MEANS OF TANNIN.

By Dr. O. N. WITT.

Among the methods proposed for fixing basic aniline dyes upon cotton one only has found general acceptance and application—the formation upon the fibre of insoluble tannin compounds.

Most tinctorial bases are polyvalent. Hence it is natural that they are capable of forming several compounds with tannin differing essentially in their properties. In all these compounds, however, a definite molecular proportion between colouring-matter and tannin has not yet been ascertained.

If the solution of any basic dye is mixed with a solution of tannin, precipitation takes place, but it is neither complete nor has the lake the properties required by the dyer. For complete precipitation, and for the production of a good green, it is necessary to saturate the acid set free from the colouring-matter, which is best effected by means of soda crystals. According to J. Kœchlin the best results are obtained with the following proportions:—For magenta, 4 parts dye, 5 parts tannin, 2 parts soda; for violets and malachite-green, 4 parts colour, 5 parts tannin, and 1 part soda crystals; for methyl-green, 4 parts colour, 10 parts tannin, 4 parts soda.

If the insoluble tannin lakes thus obtained are treated with solution of tannin they take up additional proportions, but gradually lose their insolubility, and pass ultimately into solution. Hence follows the practical conclusion that to produce a good fast dye the fibre must first be saturated with solution of tannin, and then be dyed in the solution of the colour. If the procedure were reversed the tannin lake formed at first would re-dissolve in the excess of tannin. It further follows that no more tannin must be brought upon the fibre than is necessary for the production of the desired shade.

In calico-printing another property of the tannin lakes is brought into play. These compounds are very readily soluble in certain solvents, especially in acetic acid. The printer therefore mixes colour and tannin in the due proportions, adds acetic acid as a solvent, thickens with tragacanth or starch, adds sodium acetate to take up any acid liberated from the dye, and prints this mixture upon the cloth. On steaming, the acetic acid dissolves the tannin lake, enables it to penetrate into the fibre, and then escapes along with the watery vapour, leaving the colour lake in an insoluble condition upon the fibre.

But, rational as this procedure seems, the solubility of the pigment tannates in excess of tannin comes very inconveniently into play, since there may readily be an excess of tannin upon the fibre. On washing the pieces after the steaming process, a portion of the lake already fixed is dissolved under the influence of this excess of tannin, and is re-precipitated by the lime in the water upon the whites and other coloured portions of the tissue, to the great damage of the design.

It will thus be seen that tannin is an excellent means for fixing the basic colours, but that it is extremely delicate in its application, and is scarcely to be regulated in practical dyeing and printing. It was rendered perfect by the application of a further agent, which serves, on the one hand, to seize any excess of tannin and render it harmless, and, on the other, to enter into the structure of the tannin lakes and make them less sensitive to the action of an excess of tannin and of other reagents.

For this purpose a variety of metallic salts were applied, such especially as are disposed to form basic compounds. Upon this principle depend the innumerable formulæ which recommend, as mordants, tannin in conjunction with salts of iron, tin, zinc, alumina, or lead. On the same principle depends the use of glue, in cotton dyeing, as an agent for precipitating tannin.

None of these substances possess the desired qualities in so eminent a degree as the salts of antimony. Both in dyeing and in printing antimony-baths are used, though in a very different manner. The dyer introduces an antimony-bath between the tannin and the colour-bath, and produces upon the fibre in the first place an antimonial tannin compound, which he carefully frees (or should free) by washing from any excess of either ingredient before entering the goods in the colour-beck. The printer cannot adopt this method, since the lake compounded by tannin, antimony, and colour is not soluble enough in acetic acid to penetrate quickly into the fibre on steaming. The printer therefore retains his former procedure, but he passes his printed and steamed pieces, before washing, into a solution containing from ½ to 2 per cent of tartar emetic, at a temperature of 50° to 60°, or sometimes 100°. In this manner any excess of tannin is rendered insoluble, and therefore harmless. At the same time antimony is introduced into the coloured lake adhering to the fibre, and enables it after washing to resist soaping at a boil. This is especially important when the design includes alizarin and ceruleine shades, for which raising with soap is indispensable.

If we examine the decomposition which the tartar emetic undergoes in this entire process we find it an inversion of its formation. Tartar emetic is formed from acid potassium tartrate and antimony oxide by prolonged boiling, and under the influence of tannin and of the colouring-matter it is resolved into the same components.

This determines the superiority of the antimony salts above all other agents for precipitating tannin,—*i.e.*, their equilibrium is so unstable that a very slight impulse is sufficient to overturn it and destroy the molecule. The antimony oxide is fixed upon the tannated colouring-matter, and is removed from the dye-beck along with the dyed fibre. The other product of decomposition, acid potassium tartrate, remains in the beck, and becomes concentrated by continued use. We know that tartar has a solvent action upon antimony. It may therefore be foreseen that, by the continued use of such emetic-baths, a point must be reached in which the dissociation ceases; in other words, in which the solvent power for antimony of the tartar which has accumulated in the bath counterbalances the decomposing power of the tannin and of the tannated colouring-matters. When this point has been reached the beck, though still containing tartar emetic, is useless. Sometimes this mischief is encountered by the cautious addition of soda. But this is a questionable expedient, as it is scarcely possible to calculate the exact quantity of soda needed for the unknown contents of a beck which has been in use.

Such emetic-becks overcharged with tartar have some properties very troublesome to the printer. They strip off the colour lake from the fibre worse than does pure water, and transfer it to other parts of the tissue, to the injury of the design. Such antimony-becks have therefore to be rejected as useless before the limit of dissociation of the tartar emetic has been reached. We may assume that little more than the third of the antimony expended in print-works, in the form of tartar emetic, is really utilised. The rest is lost in quantity of the evils just mentioned.

Some time ago the *Chemiker Zeitung* published the analysis of a substitute for tartar emetic, which was found to be a potassium-antimony oxalate. After the recognition of the phenomena of dissociation of tartar emetic, it became important to study them in this new salt which so closely resembles tartar emetic. The experiments of Noelting and Schmied, at the Mulhouse School of Chemistry, show that the equilibrium of this salt is still more readily disturbed than that of tartar emetic, but that the dissociation product, acid potassium oxalate, has a far less solvent power upon antimony tannate than has acid potassium tartrate. In other words, the limit of dissociation for this salt lies more remote than that of tartar emetic. A given weight of the new salt can serve as a substitute for its own weight of tartar emetic, though the latter contains nearly double the proportion of antimony.

As the double oxalate is now prepared in a state of great purity, and at a price in accordance with its smaller proportion of antimony as compared with tartar emetic, antimony-becks may now be made up much more cheaply than heretofore.

In many of the receipts which are employed for printing basic aniline colours an addition of tartaric acid is prescribed, besides the above-mentioned ingredients. The purpose of this addition is to support, during steaming, the volatile acetic acid by a non-volatile organic acid) in its solvent action, and so facilitate the penetration of the tannin lake into the fibre. However useful tartaric acid may be for this purpose, it cannot be recommended with reference to the subsequent treatment with antimony. The tartaric acid washed from the cloth accelerates the point of equilibrium in the antimony-bath, and increases the waste of antimony.

Antimonial tannin lakes fixed upon the fibre bear washing, and even hot soaping, satisfactorily, and are even thereby cleared and brightened. Thorough washing after all antimonial processes must not be omitted, as any soluble antimony compounds remaining in the tissue might easily lead to unpleasant consequences.

The formation of these antimony-tannin lakes of the basic aniline colours would rank among the most perfect methods of dyeing and printing if it were possible to render the brilliant shades thus produced capable of resisting light. Until this is done alizarin, ceruleine, &c., though more difficult to fix, yet being perfectly fast, will be preferred to their more brilliant rivals.—*Chemiker Zeitung*.

A CATALOGUE OF CHEMICAL PERIODICALS.*

By H. CARRINGTON BOLTON, Ph.D.,
Professor of Chemistry in Trinity College, Hartford, Conn.

(Continued from p. 195).

Explanation of Signs.

+ Following a date signifies current at the date in question.
‖ Following a date signifies publication discontinued.

Archiv für Chemie und Meteorologie.
See Archiv für die gesammte Naturlehre.

Archiv für physiologische und pathologische Chemie.
See Beiträge zur physiologischen und pathologischen Chemie.

35. Archiv für die theoretische Chemie. Herausgegeben von Alex. Nic. Scherer. 1 vol., 8vo. Jena und Berlin, 1800—'02.

36. Archiv für die thierische Chemie. Herausgegeben von Johann Horkel, 1 vol., 8vo. Halle, 1800, '01.

37. Årsberättelse om Framstegen i Physik och Chemi till Kongl. Vetenskaps-Akademien afgiven af Jac. Berzelius. 1821—'40. 20 vols., 8vo. Stockholm, 1822—'41.

Continued under the title:

[a] Årsberättelse om Framstegen i Kemi och Mineralogi afgiven af Jac. Berzelius. 1841-'47. 7 vols., 8vo. Stockholm, 1841-'48.

Followed by:

[b] Årsberättelse om Framstegen i Kemi till Kongl. Vetenskaps-Akademien afgiven af L. F. Svanberg. 1847-'49. 3 vols., 8vo. Stockholm, 1847-'51.

Sak- och Namn-Register öfver alla af Berzelius - - - afgifna Årsberättelser (1821-'47(. På Kongl. Vetenskaps-Akademiens föranstaltande utgifvet af A. Wiemer. 1 vol., 8vo. Stockholm, 1850.

Cf. Rapport annuel sur les progrès des sciences physiques et chimiques.

Artus, W.
See Jahrbuch für ökonomische Chemie; *also* Vierteljahresschrift für technische Chemie.

38. Auswahl aller eigenthümlichen Abhandlungen und Beobachtungen in der Chemie, mit einigen Verbesserungen und Zusätzen. Herausgegeben von Lorenz Crell. 5 vols., 8vo. Leipzig, 1786, '87.

Cf. Crell, Lorenz.

39. Auswahl vorzüglicher Abhandlungen aus den sammtlichen Banden der französischen Annalen der Chemie zur vollständigen Benutzung derselben durch Ergänzung der von ihrem Anfange an den chemischen Annalen einverleibten Aufsätzen für deutsche Scheidekünstler von Lorenz von Crell. 1 vol., 8vo. Helmstadt, 1801.

Cf. Crell, Lorenz.

(To be continued).

Royal Institution.—Professor Odling will give the first of two lectures on "Organic Septics and Antiseptics" at the Royal Institution on Saturday, May 16th.

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* Advance-proofs from the *Annals of the New York Academy of Sciences*

A NEW FORM OF DROPPING FLASK.

By F. V. POOL.

It is often convenient in methods of titration in the laboratory to make use of a flask or bottle from which the standard solution can be poured or dropped and the amount of solution which has been used determined by weighing the flask or bottle of liquid before and after the operation. This method has several advantages over the ordinary volumetric one in which a burette is used, the first advantage being that of using the liquid at any ordinary temperature without making a correction for the difference between that temperature and the one at which the liquid was standardised, provided, of course, that the standardising was made with the flask and not with a burette.

This is due to the simple fact that a gramme of water or any other liquid *weighs* the same, no matter whether the temperature be 15° C. or 20° C., and if, in process of standardising, for example, a solution of $AgNO_3$, it is found that one gramme of the solution is equivalent to one milligramme (0·001 grm.) of Cl, we may use the solution (by weight) afterwards at the same temperature or any other temperature ordinarily found in the laboratory without making any correction for the same. This is not the case in using an ordinary burette and reading off the *volume* taken, for here we must make use of a table of corrections for temperature, which would give us for a range of 10° C.—say, between 25° C. and 15° C., a difference of 0·2 of 1% of the strength. That is to say, if 100 c.c. of the said solution are equivalent to 0·100 grm. of Cl, at 25° C. the same *volume* of the liquid at 15° C. would be equivalent to 0·1002 Cl. Of course this applies to all burettes which record the volume of liquid taken.

In the second place the dropping flask has an advantage over burettes which require the use of a pinchcock and rubber tube, inasmuch as we may employ in the flask a solution such as permanganate of potash or chromic acid, which would act injuriously upon the rubber tube and become itself decomposed. To obviate this difficulty in the use of burettes, recourse is had to glass stopcocks, which are expensive and not always perfect. They are also liable to stick very tightly if allowed to remain for some time in contact with KHO or NaHO solution.

The Gay-Lussac and Bink burettes are not open to the second objection, but they are attended with a difficulty which is peculiarly their own, namely, the retention of a drop of the solution at the end of the dropping tube by capillary attraction and the prevention of the free delivery of the contents of the burette.

Analysts have overcome this difficulty by inserting a stopper, provided with a glass tube and rubber mouth tube, into the top of the burette and expelling the refractory drop with the breath. This procedure answers very well, but there is a somewhat neater way, as we shall see further on. The dropping flasks in use at the present day are few in kind and very simple, being nothing but small flasks of varying capacity provided with a top or side tube and open to the objection which is found in using the burettes of Gay-Lussac and Bink. The flask here shown is an improvement upon existing forms, and has been used for some time in the laboratory and with a great deal of satisfaction. It consists of a light, flat-bottomed flask of a size determined by the capacity of the balacce upon which it is to be weighed. From one side, near the bottom, a narrow tube starts and reaches up a little higher than the body of the flask, being then turned outward like the side tube of Gay-Lussac's burette, which it resembles. In the neck of the flask a small hole is blown which, during the operation of dropping, is governed by the thumb of the manipulator. Into the neck of the flask a rubber stopper is fitted, and through this stopper a short thistle-tube is passed, the upper part of the latter being covered by a piece of thin sheet rubber, securely fastened by a piece of thread. The flask being filled with the standard solution is first counterpoised on the balance. It is then grasped around the neck, the thumb being placed very near the small hole in the side and the forefinger held just over the rubber membrane on the top.

The flask is then tipped so as to deliver the solution through the side tube, the rapidity of flow being governed by the thumb, which closes the small hole in the neck at will. If at any time during the operation a drop is formed at the end of the tube, it can easily be forced out or drawn back into the flask by the control of the thumb and forefinger. By this means any amount of delivery may be obtained from part of a drop (by touching the end of the tube to the stirring rod) to a steady stream.

After a sufficient quantity of the solution has been used, its weight is determined by replacing the flask upon the balance pan and adding weights to balance the counterpoise in the other pan. In our own laboratory we use for this purpose a balance whose capacity is 500 grammes in each pan, and a counterpoise consisting of a small pasteboard box partly filled with shot. With this it is the work of only a few seconds to counterbalance the flask, and after the titration is completed the amount of solution used is quickly ascertained by the above method of leaving the counterpoise as it was and adding weights to the pan containing the flask. The capacity of the latter is about 250 c.c. and one filling suffices for several operations, the counterpoise being changed each time by removing some of the shot.

The convenience of this modified volumetric method can be appreciated by those who usually have a number of determinations of one kind to make in a day, and it will recommend itself to all on account of the ease of manipulation, accuracy, and slight cost of the apparatus.

The adaptation of the above described contrivance to a Gay-Lussac burette is obvious. All that is necessary is to adopt a rubber stopper and thistle-tube to the burette, and to blow or drill a small hole into the side of the burette about an inch from the top.

The flasks used were made by William Baetz, 96, Fulton Street, New York.—*Journal of the American Chemical Society*.

ATMOSPHERIC ELECTRICITY.

By L. PALMIERI.

1. *Electricity with a Clear Sky*.—When within a circle of about 140 kilometres in radius neither rain, snow, or hail is falling, the electricity at the place of observation is always positive. If negative electricity is observed with a clear sky, downfall at some little distance may be inferred. As regards the daily periodicity of atmospheric electricity in calm, bright weather, two maxima and two minima may be recognised. The first maximum appears at the ninth hour of the morning; the second, which is more decided, a little after sunset. It often continues during a great part of the night. Towards daybreak a minimum appears, and a second, less distinct, in the afternoon. This daily period is easily disturbed by move-

ments of the wind, by a cloud appearing on the horizon, by a mist rising from the somma, and by other causes often hard to determine. It may be asserted that when the maxima are very considerable, or when decided maxima appear at unusual times, the sky on the following days will scarcely be serene. If the sky begins to be overcast, the electric indications grow stronger, and if at the time of the evening maximum the relative moisture increases with a heavy dew, maxima of special intensity and duration may be expected. The general assumption that atmospheric electricity becomes stronger with the altitude has not been confirmed by the observations made simultaneously on Vesuvius and at the observatory of the University. The values obtained on Vesuvius were generally smaller. As regards the yearly periodicity, lower tensions are generally observed on hot summer days. In spring and autumn the indications are stronger. In winter the values are uncertain.

2. *Electricity with a Cloudy Sky.*—In the absence of distant rain, &c., the atmospheric electricity on cloudy days is always positive. It is less intense, more variable, and without a decided daily period.

3. *Electricity in time of Rain.*—During rain, atmospheric electricity increases considerably, both at the place of observation and at some distance, even though no lightning occurs; this increase begins and disappears along with the rain. Sometimes, if rain is falling at a certain distance, the atmospheric electricity changes its sign once or repeatedly. When the rain is falling the electricity is positive; this region is surrounded by a zone of strongly negative electricity, upon which again follows a second zone of strongly positive electricity.

4. *Thunder-Rain.*—Between ordinary rain and thunder-rain the only difference is the more abundant development of electricity in the latter. The raining cloud must be regarded as a constantly flowing source of electricity. There can be no lightning without rain and thunder. The so-called "harvest lightning" is merely a distant storm. The sound of thunder cannot be heard beyond 21 kilometres, whilst lightning is perceived at a far greater distance.—*Biedermann's Centralblatt*, vol. xiii., Part 9.

ELECTROLYTIC QUANTITATIVE ANALYSIS.

By ALEXANDER CLASSEN.

For electrolysis the author recommends either galvanic elements (Bunsen, Meidinger, Leclanché, or Daniell) or thermo-electric batteries. Meidinger's elements which furnish constant currents for a long time are available only in special cases, *e.g.*, for the precipitation of copper, bismuth, and cadmium, since even when a great number of such elements are in connection the strength of the current is insufficient for the quantitative separation of most metals from the solutions of the double oxalates. These elements may either be dispensed with or replaced by the Bunsen element. For the production of feeble currents, *e.g.*, for the determination of copper, two Bunsen elements are connected with their similar poles so as to form a single large element. This combination is applicable for the determination of the above-named metals, which, if too rapidly reduced, are separated in a spongy condition.

Thermo-electric batteries are not recommended, as the strength of their current is insufficient for many determinations and as they easily get out of order. The author now uses a small Siemens magneto-electric machine, provided with an arrangement for modifying the strength of the current at will, by modifying both the velocity of revolution and the resistance. By this means he obtains currents of from 7·46 to 0·02 ampère (1 ampère = 10·436 c.c. of detonating gas per minute).

He uses a single stand fitted with a ring for the platinum capsule and with an insulated arm for the positive electrode. As a negative electrode he uses a thin platinum capsule about 35 to 37 grm. in weight, 9 centimetres in diameter, 4·2 in depth, and 225 c.c. in capacity. Nickel capsules lined with platinum, as formerly proposed by the author, have not been found serviceable. As a matter of course the platinum capsule used as a negative electrode must be absolutely clean and free from grease. Capsules which have become rough internally, or which have been scratched or bent, cannot be used. Several metals do not deposit as well in hammered capsules as in those which have been polished at the lathe.

Determination of Copper and Cadmium.—Both these metals can be deposited quantitatively, using two Bunsen elements so connected as to form a single large element. In place of dilute sulphuric acid a 15 per cent solution of ammonium chloride may be used. From 10 to 12 hours are required for the deposition of about 0·15 grm. of copper or cadmium. The end of the process, in case of copper, is preferably ascertained by means of a recently prepared solution of potassium ferrocyanide. The circumstance that copper can be quantitatively deposited from a solution mixed with ammonium oxalate in excess may be used for its separation from those metals which can be reduced only by more powerful currents.

Separation of Copper from Iron.—Mixed solutions of iron-alum and copper sulphate, containing an excess of ammonium oxalate, and electrolysed. To determine the iron in the liquid after removal of the copper, a few more grammes ammonium oxalate are added, and the liquid is electrolysed by means of two Bunsen elements connected in tension. The separation of nickel and cobalt from copper is effected in the same way as that of iron.

Separation of Copper from Chromium.—In presence of chromium oxide the copper separated is distinguished by its brilliance, a phenomenon which the author has constantly observed in the electrolysis of iron, nickel, and cobalt salts in presence of chromium oxide.

Separation of Copper from Manganese.—If the ammonium double oxalates of both metals are electrolysed as above mentioned, only a small part of the manganese is separated out at the positive electrode. The electrolysis of the solution requires a very constant current, as, if the reduction is too slow, manganese peroxide may be partially deposited at the negative electrode.

Separation of Copper from Zinc.—The separation of copper and zinc in a solution of the double oxalates is practicable only when the current is not allowed to act longer than is required for the deposition of the copper. The separation is easy if we electrolyse a solution of the two metals acidified with sulphuric acid.

The separation of copper from arsenic and antimony does not succeed if the quantity of the two latter is at all considerable. On the electrolysis of the double ammonium oxalates of copper and mercury, and copper and bismuth, both metals, as might be expected, are deposited. Cadmium can also not be separated quantitatively from copper by the electrolysis of the above-named double salts, or of the sulphuric solution. But if the solution is acidified with nitric acid both metals may be separated quantitatively.

Determination of Antimony.—Antimony can be separated electrolytically from a cold solution containing ammonium sulphide in excess. Neither free ammonia or ammonium polysulphides must be present, otherwise the deposition is not quantitative. It is best to use ammonium hydrosulphate, which should be preserved for use in small stoppered bottles. A current representing from 1·5 to 2 c.c. per minute of detonating gas is most suitable. The reduction of large quantities of antimony is difficult, 0·15 to 0·2 grm. of the metal being the limit. The separation of antimony is also practicable with sodium or potassium monosulphide or hydrosulphide in place of ammonium sulphide. Here also the quantity of antimony must not exceed 0·2 grm., and polysulphides must not be present, neither must the sulphides used contain any impurity of iron or alumina, since otherwise iron sulphide and aluminium hydroxide are deposited upon the antimony. The antimony solution after admixture with alkali sulphide should be strongly diluted with cold water. If a current of the strength of 2 to 3 c.c. detonating gas per minute is used, 0·1 grm. antimony is deposited in 4 to 5 hours. In order to find whether all the antimony has been precipitated the liquid is allowed to come in contact with a clean portion of the inner surface of the latter by inclining it, and the current is then allowed to act for 15 minutes. If the platinum surface remains clean the precipitation is complete. The liquid should not be allowed to become hot during electrolysis.

Determination of Tin.—Tin behaves like antimony. The solution is neutralised, if needful, with ammonia, mixed with a sufficiency of ammonium sulphide, largely diluted with water, and electrolysed with two Bunsen elements. Sodium and potassium sulphides cannot be used, at least not in a dilute solution.

Determination of Platinum.—The compounds of platinum are readily decomposed by the galvanic current, the metal being deposited at the negative electrode. A single Bunsen element is sufficient. Platinum can be determined in its salts by slightly acidulating the solution with hydrochloric or sulphuric acid, or mixing with ammonium or potassium oxalate and electrolysing at a gentle heat.

The inaccuracy of the determination of potassium as platinum potassium-chloride is well known. It might be preferable in accurate determinations of potassium (ammonia and nitrogen determinations) to determine the platinum by the electrolysis of its double salts, especially as the separation of the platinum takes less time than the desiccation of the platinum compounds.

Separation of Iron from Cobalt.—The solution of the double oxalates is electrolysed by means of two Bunsen elements connected in tension, the total weight of both metals is determined, and then the iron is estimated volumetrically. In carrying out the process the solution is mixed with a few c.c. of potassium oxalate, (1 : 3) from 2 to 4 grms. of ammonium oxalate according to the quantity, and the liquid is then electrolysed at a gentle heat. The electrolysis is complete in from 3 to 5 hours. On titrating the solution of the two metals nickel sulphate must be added to compensate the red colour of the cobalt.

Separation of Iron and Nickel.—The process is exactly as in the last mentioned case. Iron and nickel separate out in the form of a white alloy, which dissolves slowly in hot hydrochloric acid. The solution is then oxidised with hydrogen peroxide, and after expelling excess the ferric chloride is titrated with stannous chloride.

Separation of Iron and Zinc.—If the double oxalates are electrolysed there is deposited at the negative electrode, not an alloy, but zinc with a little iron. The process goes on smoothly, and the sum of the two metals can be readily determined if the zinc is less than one-third of the iron. If the proportion of the former metal is higher the determination is impossible, as the zinc re-dissolves, with an abundant escape of gas, and ferric oxide is precipitated.

Separation of Iron from Uranium.—A large excess of ammonium oxalate is needed. The reduction of the iron is quickly effected by means of two Bunsen elements. Stronger currents are not to be recommended. After the determination of the iron the solution of uranium is freed from oxalic acid by further electrolysis with stronger currents, and the ammonium carbonate is driven off by heat. The finely divided uranium precipitate is dissolved in hot nitric acid and thrown down with ammonia.

Separation of Zinc and Chromium.—The quantitative separation of zinc and chromic oxide is readily effected by means of a small excess of ammonium oxalate and a current of about 10 c.c. of detonating gas per minute. To determine the chrome the oxalic acid is destroyed and the chromium oxide peroxidised by continued electrolysis, the liquid is boiled, reduced again with alcohol and hydrochloric acid, and the chromium oxide precipitated.

Separation of Zinc from Uranium.—The separation is effected by means of two Bunsen elements with a large excess of ammonium oxalate. After removal of the zinc the uranium is determined as above.

Separation of Chromium Oxide from Uranium.—The separation depends on the electrolysis of the double ammonium oxalates and oxidation of the chromium sesquioxide to chromic acid by the current. The uranium is precipitated as hydroxide, and the chromium remains in solution as ammonium chromate. The electrolysis must be continued until the oxalic acid is totally decomposed. The liquid is then boiled, allowed to stand for six hours, and the chrome determined as above.

Separation of Cobalt from Chrome.—This process resembles the separation of zinc and chrome. The cobalt is separated from the solution of the ammonium double oxalates, and the chrome is determined as above. As the cobalt is entirely separated before the oxidation of the chrome begins, the current should be interrupted after its deposition, as it may otherwise be re-dissolved by the ammonium hydrocarbonate.

Separation of Cobalt from Chromium and Manganese.—After the separation of the chrome the solution is further electrolysed for the decomposition of the oxalic acid and the peroxidation of the chrome, and is then boiled for some time. Hydrogen peroxide or bromine water is then added; the liquid is rendered alkaline with potassa and the manganese is determined as sulphate or as mangano-manganic oxide. The filtrate is then treated as in the separation of zinc from chrome.—*Berichte der Deutschen Chemischen Gesellschaft.*

THE MANUFACTURE OF BLACK-LEAD CRUCIBLES.

By JAMES C. BOOTH, Ph.D.

(Concluded from p. 55).

Pulverising the Graphite.—The manner of grinding graphite being of considerable influence on the quality of the crucible, some details upon the subject will be proper and useful. The larger masses of graphite being roughly broken by hammer into smaller pieces, the whole mixture of pieces and fine stuff is fed into an ordinary bark mill, consisting of two cast iron inverted cones, the smaller with iron teeth on its outer surface, revolving inside the larger one, similarly armed on its inner surface. The lumps are caught and crushed between these cones, and the resulting coarse and fine powder, being immediately passed between ordinary mill-stones, is ground to a more uniform and finer powder, which is then assorted by sieves into finer and coarser portions, the latter being again ground and sifted until the requisite fineness is attained.

I have nothing to suggest to improve the machinery or mode of grinding, but as I differ from crucible makers in regard to the degree of fineness, I here present my views and the reasons for them. To economise time the ground graphite, passing through the sieves and consisting of fine flour on one extreme and on the other of flakes that can be split by a knife or ground to thinner scales, is usually mixed directly with the wet clay.

I regard the coarser flakes of insufficiently ground graphite as positively objectionable, because they lessen the strength of the crucible, which is the supreme consideration. I have often observed the surfaces of spalls split off from a crucible while in use, and noticed on them graphite scales of $\frac{1}{8}$ inch or more in diameter, with a part of the same scales remaining on the crucible and in the same spot. The knife easily separated more scales from the corresponding locality on spall and crucible. The facility of splitting offered by these graphite scales increases the facility with which pieces of the crucible itself split off through the feebly adhering laminations of the graphite. I have often seen a half dozen such scaling plates of graphite on a spalled surface of 2 to 4 square inches, and instantly read the cause of spalling and of serious injury to the crucible. If those coarser and thicker plates of graphite had been ground, spalling would not have occurred. Graphite is a very feeble substance in the plane of its lamination, but strongly resists a force at right angles to this plane, and, what is more extraordinary, it will do so at a white heat.

Hence black-lead should be ground exceedingly fine, not leaving a plate of it more than $\frac{1}{20}$ to $\frac{1}{50}$ inch in diameter. I have tried crucibles made of black-lead powder that would not quite pass through a 126 wire sieve, and found them excellent. The dust that passed through such a sieve consisted of about 75 per cent of good and tough flakes, and 25 per cent of a fine black powder, without apparent structure, consisting of siliceous sand and iron pyrites. "If fine grinding were adopted," the economic manufacturer asks, "What should be done with the fine powder passing the 125 wire sieve?" About $\frac{1}{8}$ of it, being siliceous, is not hurtful, but the $\frac{1}{8}$ iron pyrites is injurious, and although it is so exceedingly small in quantity, yet it would be preferable to utilise it in one of three ways: (1.) To separate it by a still finer sieve into good flaky graphite, to be used with the rest, and dirt, to be thrown away; or, (2) To use it in mixture with good material for covers, &c.; or, (3) To sell the whole mass passing the 125 sieve, with other inferior residues, for stove blacking, &c. In such case it may sell for half the value of good black-lead.

Clay.—Admirable as are the qualities of black-lead to resist the action of a white heat, burning off as it does only partially and with some difficulty, it must, in order to hold melted metal, be held firmly in the crucible shape given to it, and this is effected by clay, that when wet mixes easily with the powdered black-lead, and when dried and burned holds it rigidly and at the same time resists the highest white heat of the furnace. A clay from Klingenburg in the Palatinate seems to be pre-eminently adapted for such crucibles, and I strongly advise employing exclusively the best quality, every lump of which has the Government stamp impressed on it.

I have tried lower grades of the Klingenburg, and some of our own clays (Amboy, &c.), but I have found none to combine the excellent qualities of the best Klingenburg. In its wet state it is superlatively plastic, and free from every trace of grit, and in this state can be blended most intimately with the fine scales of black-lead. It is barely fusible by itself at a white heat, and when mixed with an equal quantity of graphitic scales, as in the crucible mass, it only softens at a white heat so far as to surround each scale, which it holds immovably in its place, while the equal quantity of scales prevents any further fusion, even when kept for ten or more hours at the highest white heat. Viewed chemically, Klingenberg clay is a hydrated silicate, containing in round numbers about $\frac{3}{8}$ alumina, $\frac{1}{8}$ water, and the balance silica, with minute quantities of oxide of iron, and alkaline fluxing matter. In its employment for fire crucibles, the only consideration is its content of $\frac{1}{8}$ water when calculating the weights of the ingredients.

Sand.—The third constituent of the graphite crucible is a rather coarse siliceous sand that will stand a high heat without flying into fine powder. Its action is mechanical, causing a more uniform air drying, previous to burning, so as to avoid cracking, and playing the limited part of a skeleton to maintain the shape of the crucible. A good infusible clay, hardened by burning, and broken and sifted as a coarse sand, was found to act as well as sand, but not perceptibly better.

Mixture for Crucibles.—The only point of agreement in the composition of the best crucibles seems to be that when burned they should contain over 50 per cent carbon, as determined by analysis. The formula may vary within rather wide limits, but our experience with good crucibles of the best makers and with our own, indicated that the burned crucible should show 55 per cent carbon on analysis. In calculating the quantity of black-lead used in a crucible from the determination of carbon, it is only safe to add 6 per cent for the siliceous sand and pyrites found in the black-lead. Some of the choicest black-lead grains now in commerce have scarcely 1 per cent of foreign matter, so entirely has the earthly constituents of plants or the small percentage of ash in anthracite disappeared from the mineral graphite. The proportions of black-lead, air dried clay and sand used by different makers, and by the same maker at different times, vary considerably, but the following is given as illustrating approximately the composition for making the convenient amount of about 2000 lbs of crucible mixture when burned. As a crucible maker, I prefer the weight of black-lead to be 1100 lbs., so that the burned clay and sand may together make up about 1000 lbs., which will give the 55 per cent carbon in the burned crucible:—

Black Lead.	Air Dried Clay.	Sand.	Total, when burned.
1100	1000	120	2100
1100	950	160	1996
1100	900	200	1990

Every manufacturer prefers such composition as, in his judgment, works best in practice.

Mixing.—The air-dried clay of a given weight for a batch of crucibles, after being roughly broken by hammer, is covered with water, and after being softened, by standing, to a thin paste, receives the due proportions of the finely ground and sifted black-lead and sand, and is then partially incorporated by a shovel. Some makers, ambitious of reputation for quality, judiciously pass their hands through the incorporated mixture to detect and remove lumps of gravel of pyrites or quartz. No amount of hand or shovel mixing can equal or supersede the operations of the mixer or dolly-tub, a wooden vat of 4 or 5 ft. in diameter and height, standing on end, to which the somewhat stiff pasty mass is transferred. Its simple machinery is a vertical shaft, revolving on the centre of the bottom, and provided with a series of horizontal knives, arranged at a distance from each other spirally, and extending nearly to the sides of the tub. The revolving knives, having their blades at a slight angle to the plane of revolution, cut the putty-like mass into separate strips which fall over the sloping blades, and again unite in neat layers, to be again cut, separated, reunited, in new positions. After thus working for some time a slide on the outside of the tub, near the bottom, is drawn and the blades slope in such a direction to their revolution that they pass the mass downwards and out of the sliding door. The protruding masses are cut off and thrown in above, and this operation, often repeated, has the effect of blending the whole into a stiff paste of absolutely uniform composition, so that each flake of the graphite, $\frac{1}{1000}$ inch diameter, is enveloped in plastic clay, and every particle of clay is in contact with a flake. The wonderful strength of the black-lead crucible is due to this microscopic blending of graphite and clay.

To make the crucible still more perfect the finished mass of about a ton in weight should be laid by in a damp cellar, covered with cloths, and occasionally moistened. In spite of the restless and reckless driving of our American manufacturers, they recognise that in all clay wares the ready-mixed masses kept for a long time make better wares than those freshly squeezed out of the dolly tub. The experience of the Chinese for ages in making the finest clay wares, led a potter to accumulate a quantity of mixed batches, ready for use, during ten, twenty-five, and more years to be used by his son, grandson, &c., as in the case of some that had been similarly bequeathed to him.

Can this part of the manufacture of graphite crucibles, *i.e.*, making the dough, be improved? I offer the two following suggestions for consideration: 1. Scarcely any native clay is wholly free from occasional lumps of iron pyrites, which, happening to become located in the side of a crucible, might ruin the metal near it, or make a hole for the metal to escape, and in either case injure the reputation of the maker. Careful makers sometimes feel for such in the soft clay mass, but why may not this mass be passed between rollers of very small diameter, which would not pass the small gravel or lumps, but accumulate them on the feeding plate? If such arrangement will pay in brick or terra cotta ware, surely the costly crucible mass would bear it. 2. The roughly mixed crucible mass, made very liquid with water, might be passed through rotating sieves, of smaller meshes than the sand, and the slip evaporated to proper consistence on shallow furnaces similar to those employed in drying white-lead. These suggestions can only be answered by the crucible maker on the ground of perfection of work and economy.

Moulding.—All graphite crucibles, between Nos. 30 and 80, embracing those for steel, brass, silver, &c., are formed on plaster moulds, centered on the potter's table, or throwing lathe. The weighted mass for a crucible, being repeatedly cut and "slapped," is pressed into the bottom of the mould, which shapes the outside of the crucible, and, while rapidly revolving, a steel or iron profile of the interior is gradually lowered into the mass, which is thus pressed against the sides and raised to the top of the mould by revolution, and gives the form of the interior of the crucible. This revolving method, like the ancient potter's throwing lathe, is far more important in this art, because it effectually disposes every scale of graphite, tangentially to the cylindrical or conical walls of the crucible, not merely on the inside and outside, but throughout the whole mass. Here lies the great strength of the graphite crucible. It is a mass of strong scales of carbon, that will not break at right angles to their lamination, being rigidly held in their sheet-like disposal by burnt clay, that will not yield to any heat. It is a graphite crucible, infusible and unalterable, where the black-lead is very much, nd for a long time, prevented from burning away by its envelope of clay. It is a clay crucible, which will not soften in the highest ten-hour, white heat employed in the arts, and will endure ten times the roughest usuage in any other material, except bar iron. For many years I employed excellent wrought iron crucibles for melting silver, but find that black-lead crucibles are better adapted to the purpose.

The proposition to make a cheaper graphite crucible by merely pressing out the soft crucible mass in moulds, without the loss of time in revolving, would utterly fail for lack of the strength of structure given by revolution. In like manner the suggested substitution of anthracite, or any other form of carbon, for graphite, would signally fail to approximate to the strength and other qualities of a black-lead crucible.

Drying is effected by keeping the formed crucible in the plaster moulds for a time, and then ranging them on shelves in warm, dry air, most economically in the spaces around the upper half of the burning kiln. If dried too rapidly, or if frost be allowed to enter the drying-room, fine cracks, like crooked hair lines, barely visible, around the interior, indicate that the crucible should be re-made from the foundation.

Burning.—The crucibles must be thoroughly burned, and yet so as to avoid burning out black-lead, their chief source of strength and value. To attain this object they are burned in seggars, which more or less exclude air, using two seggars for each crucible, one inverted over the other, and yet graphite is sometimes partly burned out by the air entering between them. This has been partially obviated, by some makers, by smearing the joint on the outside with clay slip. Another method which I invented, but never put into practice, as I soon after gave up the manufacture, consisted in replacing the oxygen of the air in the crucible and seggar with carbonic acid. I proposed to effect this by putting a small quantity of anthracite, or of rather dry bituminous coal, around the inner part of the lower seggar, and also, if practicable, a little of the same inside the crucible itself, avoiding defacing scratches or marks, which would be suspicious in the eyes of a buyer. I still suggest this idea to the manufacturer, for as long as there is present an easier burning carbon than graphite, the former will be attacked to the safety of the latter; and, moreover, the carbonic acid formed and forming from the coal excludes the oxygen of the air, or the latter is consumed immediately on entering. A dry gaseous coal that neither puffs nor melts would be best for this purpose.

To secure equal and uniform distribution of heat, the furnace should have, and usually has, many openings as firing hearths around its base, and when the burning is nearly complete, these should be more or less closed, so as to prevent the entrance of more air than is barely necessary to maintain the diminishing combustion while the furnace is beginning to cool. This is another method of preventing the loss of black-lead, and, with the same object, the entrance of air from above downwards should be prevented or counteracted.

The amount of carelessness or ignorance, or lack of attention to prevent burning out of black-lead and possibly imparing the strength of a crucible, may be readily ascertained on the burned ware. When the outside of a crucible has the usual black-lead colour, it is either not burned enough, and then quite soft to the nail or knife, or it is extremely well burned, to be determined also by hardness under knife or nail, or it may have received the outside cleanly operation of a brush, which is, of course, only outside, and condemnatory. An outside drab colour, which is the prevailing one, indicates burning off black-lead. If the drab colour be very shallow and show the subjacent black by friction of the finger, then it is well burned, like the greater part of the crucibles in commerce. Even if a slight scratch with a knife show the black immediately under the outside, it still shows excellent burning. But if it require a little digging into the drab before coming to the black-lead, say ¼ inch, I should be disposed to throw off one-fourth, or more, of its value. If it go to a half inch, I should reject such a crucible as worthless, because a large proportion of its life, its strength, has been burned out.

Use and Life of Black-Lead Crucibles.—The most extensive use of black-lead crucibles is to melt blistered steel and cast it into any desired form, whence it is termed cast-steel. Tens of thousands of crucibles are weekly employed [for this purpose, the amount of steel at each melt being from 75 to 90 pounds, and a number of such melts constituting a day's work. Hence the great multiplication of furnaces, or of crucibles in a gas furnace, when 1000 pounds or more are cast at a time. The life of a crucible for melting steel varies with the nature of the steel to be cast. If it be a highly carbonised (fine) steel, a moderate white heat will soon melt it, and the crucible may be repeatedly used. If a low (common) steel be employed, approximating to bar iron, such as a locomotive driving wheel, the crucible has to endure five (5) and more hours of the most intense white heat for a single casting, and yet it can endure several such meltings. A crucible will bear repeated meltings of tool steel, and in order to extend its life, the outside is often coated with a good clay slip, with or without an admixture of black-lead, after each melt. The wonderful protective power of the clay, embracing each particle of black-lead, shows the advantage of grinding the black-lead to great fineness, making clay and graphite mutually protective. In melting steel, the melter has to consider the length of the time of melting, and, therefore, the quantity of additional carbon the steel is assuming from the black-lead pot, which excess he neutralises by adding a certain quantity of scraps of bar-iron to the melt.

To show other possible applications of the crucible mass I may mention that syphons have been constructed of it, and successfully employed for transferring melted cast-iron from one vessel to another.

Black-lead crucibles are also extensively employed in melting brass, bronze, German silver, gold and silver. I here add a few data in relation to the last two metals. The crucibles employed at the U.S. Mint, at Philadelphia, are so called No. 70 pots, of three gallons capacity—being 9 inches in diameter at the top and 13 inches deep, both inside measurement. The walls are 1 inch thick at top, and 1½—2 inches at bottom. In such a crucible we usually melt at once, every 1½ hours, 5400 ounces of standard gold ($\frac{9}{10}$ pure), or 370 pounds, avoirdupois; four melts a moderate day's work, equal, therefore, to 1480 pounds, or 21,600 ounces. The value of such a single melt is over 100,000 dols. One such crucible is run for four days with full confidence in its safety, and fearing no fracture or loss of gold; for although we have run them for six (6) days it is found the economy does not balance the possible danger of fracture and leaking. Taking the safe run of four days, we melt in a single crucible, with scarcely any loss, 1,600,000 dols. worth of gold at the crucible cost of about 2 dols. 50 cents.

We usually melt 3500 ounces (=240 pounds, avoirdupois), of standard silver in a crucible (No. 70) at one melt, and cast six such melts, without undue haste, in a day, making 1440 pounds, or 21,000 ounces. Since it is safe to estimate its life at five days, we melt in one such crucible before it is laid aside 7200 pounds (=105,000 ounces) of standard silver, or about the same amount in dollar value. This, however, is not all of its life, but only its manhood, for after doing duty for so long a time in perfect health, it is put aside to purify and toughen inferior silver and to gather into melts grains and residues, otherwise wandering off, for some time before it is thoroughly disabled and ground to powder, to recover the precious grains which it has concealed in its body.

To one who knows the ease with which alkalies attack clay at a high heat, and how readily fusing nitre will burn off carbon, even black-lead, it is quite a surprise to witness the wonderful durability of the black-lead crucible, when in its nearly worn out condition it is used for fluxing residues, and we can only attribute its strength to the minute and intimate blending of clay and graphite, mutually resisting destruction.

No doubt the life of these crucibles is prolonged in melting bronze, brass, &c., because they are so tough through the blending of clay and graphite that they rarely break suddenly, but rather give notice of their intention to do so by gradually opening, and even then not until they have been worn thin by long use.

Some years ago I prepared some black-lead crucibles with more than usual care in order to test their life. We made from 40 melts of silver, the lowest limits, to 60 melts, the higher limit, in a single crucible. I have no doubt that a careful study of the principles of the manufacture of black-lead crucibles here developed, somewhat fully, and even perchance their further development, beyond my conception, can improve their quality so as to double the life and strength ascribed to them.—*Journal of the American Chemical Society.*

PROCEEDINGS OF SOCIETIES.

MANCHESTER LITERARY AND PHILOSOPHICAL SOCIETY.

Ordinary Meeting, March 10th, 1885.

Professor W. C. Williamson, F.R.S., President,
in the chair.

"*On Making Sea Water Potable,*" by Thomas Kay, President of the Stockport Natural History Society. Communicated by F. J. Faraday, F.L.S.

The author called attention to the absence of research in this direction, and how man, endowed to overcome every physical disability which encompassed him on land, was powerless to live on the wide ocean, although it is teeming with life.

The water for experiment was taken from the English Channel, about 50 miles south-west of the Eddystone Lighthouse, and it was found to correspond closely with the analysis of the Atlantic, published by Roscoe, viz.:—Total solids 35·976, of which the total chlorides are 32·730, representing 19·868 of chlorine.

The waters of the Irish Sea and the English Channel nearer to the German Ocean, from their neighbourhood to great rivers, are weaker than the above.

Schweitzer's analysis of the waters of the English Channel, near Brighton, was taken as representing the composition of the sea, and is here given:—

Sodium chloride..	27·059
Potassium ,, ...	0·766
Magnesium ,, ...	3·666
,, bromide	0·029
,, sulphate	2·296
Calcium ,, ...	1·406
,, carbonate	0·033
Iodine and ammoniacal salts ..	traces
Water..	964·795
	1000·000

The chlorides in the Irish Sea are about 30 per mille.
,, English Channel ,, 31 ,, ,,
,, beyond the Eddystone are 32 ,, ,,

As the requirement for a potable sea water does not arise except in mid-ocean, the proportion of 32· per mille. must be taken as the basis of calculation.

This represents as near 20· per mille. of chlorine as possible.

From the analysis shown it will be perceived that the chlorides of sodium and magnesium are in great preponderance.

It is to the former of these that the baneful effects of sea-water when drunk are to be ascribed, for chloride of sodium or common salt produces thirst, probably by its styptic action on the salivary glands, and scurvy by its deleterious action of the blood when taken in excess.

Sodium chloride being the principal noxious element in sea-water, and soda in combination with a vegetable or organic acid, such as citric acid, tartaric acid, or malic acid, being innocuous, the conclusion is that the element of evil to be voided is *chlorine.*

After describing various experiments and calling attention to the power of earthy matters in abstracting salts from solutions by which he hoped the process would be perfected, an imperial pint of water from beyond the Eddystone was shown mixed with 960 grains of citrate of silver and 4 grains of free citric acid.

Each part of the chlorides requires three parts by weight of the silver citrate to throw down the chlorine, thus:—

$$3NaCl + Ag_3C_6H_5O_7 = Na3 . C_6H_5O_7 + 3Ag.Cl.$$

The silver chloride formed a dense insoluble precipitate, and the supernatant fluid was decanted and filtered through a rubber tube and handed round as a beverage.

It contained in each fluid ounce by calculation about—

18	grains	of citrate of soda
1½	,,	,, magnesia
½	,,	,, potash
1	,,	sulphate of magnesia
½	,,	,, lime
⅕	,,	citric acid

with less than half a grain of undecomposed chlorides.

To analyse this liquid therapeutically, it may be broadly stated that salts of potash are *diuretic*, salts of magnesia *aperient*, and salts of soda *neutral*, except in excessive doses or in combination with acids of varying medicinal action; thus, soda in nitric acid, nitrate of soda is a *diuretic*, following the law of nitrates as nitrate of potash, a most powerful diuretic, nitrous ether, &c.; whilst soda in combination with sulphuric acid as sulphate of soda is *aperient*, following the law of sulphates which increase aperient action, as in sulphate of magnesia, &c.

Thus it would seem that soda holds the scales evenly between potash and magnesia in this medical sense, and that it is weighed, so to speak, on either side by the kind of mineral acid with which it may be combined.

With non-poisonous vegetable acids, and these slightly in excess, there is not such an effect produced.

Sodium is an important constituent of the human body, and citric acid, from its carbon, almost a food. Although no one would advocate saline drinks in excess, yet, under especial circumstances, the solution of it in the form of citrate can hardly be hurtful when used to moisten the throat and tongue, for it will never be used under circumstances where it can be taken in large quantities.

In the converted sea-water the bulk of the solids is composed of inert citrate of soda. There is a little citrate of potash, which is a feeble diuretic; a little citrate and sulphate of magnesia, a slight aperient, corrected, however, by the constipatory half grain of sulphate of lime; so that the whole practically is inoperative.

The combination of these salts in nature's proportions would seem to indicate that they must be the best for administration in those ailments to which their use would be beneficial.

Citrate of silver is an almost insoluble salt, and requires to be kept from the light, air, and organic matter, it being very easily decomposed.

A stoppered bottle covered with india-rubber was exhibited as indicating a suitable preserver of the salt, as it affords protection against light, air, and breakage.

As one ounce of silver citrate will convert half a pint of sea-water into a drinkable fluid, and a man can keep alive upon it a day, then seven ounces of it will keep him a week, and so on, it may not unreasonably be hoped, in proportion.

It is proposed to pack the silver citrate in hermetically sealed rubber covered bottles or tubes, to be inserted under the canisters or thwarts of the life-boats in ocean going vessels, and this can be done at a simple interest on the first outlay, without any loss by depreciation, as it will always be worth its cost, and be invaluable in case of need.

RUSSIAN PHYSICO-CHEMICAL SOCIETY.

Chemical Section.

March 7/19, 1885.

The President, Prof. D. Mendeleiff, in the Chair.

1. T. Kleiber made a communication on the "Chemical Composition of Celestial Bodies."

A. Butlerow communicated the following work done in the laboratory of the Kazan University:—

2. S. Reformatsky, "On the Preparation of Polyatomic Alcohols and their Derivatives by the Action of Hypochlorous Acid."

3. A. Zaitzeff, "On the Synthesis of Saturated Tertiary Alcohols from Ketones."

N. Menshutkin presented the following papers:—

4. M. Shalfeieff, "On the Action of Ammonia upon Hæmin."

5. A. Sabaneieff, "On the Preparation and Polymerisation of Bromacetylene."

6. N. Menshutkin, an additional remark to his "Investigation on the Formation and Decomposition of Amides and Anilides."

7. N. Liubavin read a paper on the "Action of Methyl-iodide upon Carbylamine."

8. The same author communicated a remark of A. Ordinsky on the "Volumetric Determination of Phosphoric Acid by the Use of Cochineal Tincture and Uranium Salts."

9. A. Favorsky had studied the action of dry and alcoholic caustic potash on the products obtained by phosphorus pentachloride from methyl-ethyl and methyl-propyl ketone. In the first case ethyl acetylene and propyl-acetylene are formed, whilst on using alcoholic alkali solution these hydrocarbons originally formed are isomerised into the bi-substituted acetylenes, viz., dimethyl-acetylene and methyl-ethyl-acetylene.

10. I. Kondakoff described a secondary unsaturated alcohol obtained from the products of the action of chlorine on trimethyl-ethylene; the alcohol methyl-iso-propenyl-carbinol is isomerised by the action of sulphuric acid into methyl-iso-propyl-ketone.

11. The same author also made a preliminary communication on the "Action of Chlorine on Iso-propyl ethylene."

12. M. Lvoff communicated a work of V. Solonina on the "Action of Diluted Acids on Allyl-alcohol." The alcohol being first isomerised to propyl-aldehyd, and then yielding an unsaturated aldehyd, $C_5H_{10}O$.

13. N. Kaiander pointed out the inaccuracy of the methods hitherto used in correcting thermo-chemical data upon the contraction of solid and liquid bodies in reactions, and proposed a more accurate method, which he has applied to the combinations of alcohol and water, to the hydration of sodium carbonate and sulphate, and to the formation of sodium sulphate from sodium oxide and sulphuric anhydride.

The 3rd part of the *Journal* contains the following papers:—

1. V. Alexeieff. "On Mutual Solubility of Liquids." The solubility of liquid sulphur and some hydrocarbon compounds in each other was studied and the curves representing it found to be regular and analogous to those for water and phenol and water and aniline.

2. G. Wachtel. "On the Manufacture of Potassium Dichromate." The best yield of chromium oxide from chrome iron is obtained by heating it with a mixture of equal parts of potassium carbonate and lime.

3. P. Alexeieff. "On the Action of Light on Nitrocuminic Acid." The red body formed is stated to be a colouring matter, and the light to act in an analogous manner upon nitrocuminol and ethyl-nitrocuminate, whilst nitrohydroxy-cuminic acid is not influenced by light.

4. A. Krakan. "On Isomeric Benzene Derivatives, according to the Theory of Substitution."

5. N. Kaiander. "Remarks on Menshutkin's paper on 'Isomerism of Hydrocarbons.'"

6. A. Gorbov and A. Kessler. "On an Apparatus for Fractional Distillation under Diminished Pressure. A Modification of D. Konovalov's apparatus (*Berl. Ber.*, 17, 1535).

7. S. Przibytek, "On Diallyl-dioxide." It is formed by treating the dichlorhydrine obtained by additions of hypochlorous acid to diallyl with dry caustic potash. Being heated with water it yields the first anhydride of hexyl-erythrol.

8. A. Butlerow, "On Chemical Structure and the Theory of Substitution."

NOTICES OF BOOKS.

A Treatise on Practical Chemistry and Qualitative Inorganic Analysis. By F. Clowes, D.Sc., F.C.S., &c. Fourth Edition. London: J. and A. Churchill.

This work, from the mere fact of its having reached a fourth edition, must have been found useful. Indeed, on looking over the instructions given for the preparation and use of apparatus, for the performance of analytical operations, and for the application of reagents, we are most agreeably struck with the thoroughness which the author seeks to instil into the student. To give a single instance, when testing for phosphoric acid with the well-known molybdic reagent, the student is reminded that a relative excess of phosphate prevents entirely the formation of the precipitate. A case once came under our notice, where, from ignorance or neglect of this simple fact, a rich phosphatic turnip-manure was reported entirely free from phosphoric acid, although fragments of bone, recognisable as such even by the naked eye, could be picked out of the sample.

Mr. Clowes does not, like some authors of elementary treatises, omit the rarer elements, but he gives their reactions, as well as those of certain important organic substances, in a distinct section.

Concerning the use of methylated spirit in lamps, we have to differ from the author. This liquid, as ordinarily procurable without most troublesome formalities, contains a large amount of shellac, and deposits an abundance of soot upon capsules or crucibles heated over it. In fact, it is rendered practically useless to everyone, save the varnish manufacturer.

A greater use is here made of formulæ—which do not in all cases fulfil the purpose of a short-hand—than is met with, *e.g.*, in the great work of Fresenius. The author, however, to do him justice, does not make his book a " listed field " for the discussion of theories and conflicting systems of notation.

The *banal* references to examinations do not fail to present themselves in the preface. Yet Mr. Clowes does not think it essential to encumber his pages with lists of questions which have been put to candidates by the various examining bodies.

One painful reflection is suggested by the last paragraph of the preface. If the demand for sound practical laboratory instruction is rapidly increasing, how comes it that our national harvest of discoveries and inventions in chemistry remains so comparatively small?

Table to Facilitate Chemical Calculations. Compiled by W. Dittmar, F.R.S., Professor of Chemistry at Anderson's College, Glasgow, with the assistance of John M'Arthur, Archibald Kling, and Thomas Barbour. Second Edition. Glasgow: James Maclehose. London: Williams and Norgate.

This work opens with a series of explanatory notes. Next follows a table of atomic weights. Here, as regards zinc, the author has adopted the means of the determinations of Marignac and Baubigny. To cobalt and nickel he gives equal atomic weights. Generally speaking this edition differs little from the previous one. A few errors—difficult to avoid in tables like those before us—have been corrected. A chapter has been added on the calculation of gas-analyses, a translation essentially of a contribution of the author's to a German work, the *Neues Handwörterbuch der Chemie.* Here there occurs a word which we never met with before, either in the technical language of chemistry or in common life. The author speaks of " an un-analysed mixture of gases of that *slump* composition."

No further edition of these tables will appear in their present form, as they will be incorporated in a manual of chemical arithmetic which Professor Dittmar is preparing.

CORRESPONDENCE.

SOLUBILITY OF MANGANESE FERRICYANIDE IN HCl.

To the Editor of the Chemical News.

Sir,—Will you permit me to ask Mr. Deane (Chemical News, vol. li., p. 164), to state somewhat more in detail the data from which he has arrived at the conclusion that manganese ferricyanide is soluble in hydrochloric acid. I have made the experiment with some care, and have come to the conclusion that, although there is an *apparent* solution of the ferricyanide, this is not really the case, but that decomposition takes place. The warmed liquid smells strongly of hydrochloric acid, and deposits upon cooling, sooner or later, prussian blue. The filtrate contains manganese and iron as chlorides, but *not* manganese ferricyanide.

It is unfortunately far too common to speak of the decomposition of a salt by an acid as the solution of that salt.

Surely in a solution the salt dissolved must be capable of being recovered upon evaporation. This is certainly not the case in this instance.

I should like to add the not, I believe, hitherto noted fact, that manganese ferricyanide is soluble in *water*, and that its solution, upon evaporation, leaves the salt in the form of glistening brown scales.—I am, &c.,

Carter N. Draper.

Wiesbaden, April 22, 1885.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

Note.—All degrees of temperature are Centigrade unless otherwise expressed.

Comptes Rendus Hebdomadaires des Séances, del'Académie des Sciences. Vol. c., No. 16, April 20, 1885.

New Process for the Liquefaction of Oxygen.—M. L. Cailletet.—Will be inserted in full.

On the Purple of Cassius.—H. Debray.—The author points out that he had, previously to the recent paper of Max Müller (*Journal f. Praktishe Chemie*) demonstrated that the colour of this pigment is due, not to an oxide of gold, but to metallic gold in a state of minute sub-division. M. Müller, however, differs from the author in ascribing no influence to the matter which the gold colours.

Two New Indicators for the Volumetric Determination of Caustic Alkalies in Presence of Carbonates.—R. Engel and J. Ville.—M. Degener and M. Warder have recommended respectively phenolacetine and phenolphthaleine as indicators for the determination of free bases in presence of carbonates. The authors have for some time employed for the same purpose two other indicators, one of which especially indicates the completion of the operation with much more precision than the foregoing. The first of these reagents is sulph-indigotic acid. This reagent is prepared by neutralising with calcium carbonate the ordinary solution of indigo in fuming sulphuric acid, diluting with 10 vols. of water, and filtering. The alkaline carbonates do not alter the blue colour of the liquid, whilst caustic potash and soda turn it to a yellow. To titrate, *e.g.*, caustic potash in presence of potassium carbonate we add to the mixture two or three drops of the reagent. The liquid turns to a yellow and becomes blue again as soon as the neutralisation of the caustic potash is complete, and there merely remains potassium carbonate in the solution. A green colour precedes the decidedly blue shade, but if we place the beaker on white paper it is easy to see that each drop of standard sulphuric acid determines a blue spot in that part of the liquid. The acid is added until the liquid has become uniformly blue, and this change of colour is no longer perceptible. The soluble blue, C. 4 B. of Poirrier dissolved in water—2 parts per 1000—is a still more sensitive reagent. The solution remains blue in presence of alkaline carbonates, but is reddened by caustic alkalies. If to such a mixture we add one drop or two of this reagent, we obtain a rose-coloured liquid, in which each drop of standard acid determines a blue colouration, which disappears again until all the caustic potash has been neutralised. The process is at an end when there is a distinctly blue colour, preceded by a violet shade. With this reagent the determination of free acids along with their carbonates is effected as rapidly and accurately as an ordinary alkalimetrical operation.

Volatility in the Oxygenated Nitriles.—L. Henry.—Not capable of useful abstraction.

Formation of Alkaloids in Diseases.—M. Villiers.—The author has extracted an alkaloid from the organs of two children who died of broncho-pneumonia following upon measles, and has examined its reactions. No alkaloid had been administered to the patients during their illness. The alkaloid was found in the lungs and the liver. It has no reaction upon litmus and is liberated by alkaline bicarbonates. Platinum chloride, potassium bichromate, tannin, and picric acid do not give any precipitate. Ferricyanide is slowly reduced. Mercuric potassium iodide and iodised potassium iodide give white precipitates.

From the alkaloid which the author has extracted from the organs of cholera patients it differs by its smell, its taste, its feeble alkalinity, and several of its reactions; its physiological effects and its mode of localisation in the body are also different. The author has, however, obtained from the body of a diphtheria patient an alkaloid which seems identical with the one first mentioned.

Bulletin de la Société Chimique de Paris.
Vol. xliii., No. 6, March 20, 1885.

Absorption of Chlorine by Carbon and its Combination with Hydrogen.—MM. Berthelot and Guntz.

Researches on Phosphorus Fluoride. — M. Berthelot.

New Method for the Measurement of the Combustion-Heat of Carbon and of the Organic Compounds. —MM. Berthelot and Vielle.

Remarks on the Principle of Maximum Work.—M. Berthelot.—Thermo-chemical papers the substance of which has been already noticed.

An Ammoniacal Zinc Sulphate and on the Separation of a Purely Aqueous Liquid into Two Strata.—G. André.—The author dissolves 100 grms. zinc sulphate in ordinary ammonia, avoiding rise of temperature, and passes into it a rapid current of ammoniacal gas, keeping the liquid cool. On interrupting the current and leaving the liquid at rest it separates into two distinct strata. If these are mixed together by stirring they present the appearance of an emulsion and soon separate again.

Biedermann's Central Blatt fur Agrikultur Chemie.
Vol. xiii., Part 9.

Influence of Salts on Nitrification in Soils.—M. Pichard.—From the *Comptes Rendus*.

Superphosphatic Gypsum, a New Material for Absorbing Ammonia in Stables.—Prof. Heiden.—The substance in question is a residue from the manufacture of phosphoric acid, and contains 4 to 5 per cent soluble and 1 to 2 per cent insoluble phosphoric acid. It retains ammonia much better than does kainite.

Cosmos les Mondes.
New Series, No. 10, April 6, 1885.

Electro-pseudolysis.—Dr. Tommasi.—To explain the difference observed between the electromotive force necessary to produce electrolysis and that which brings about a separation of the elements of the electrolyte, the author assumes that in this latter case the elements are already in part dissociated. He proposes the hypothesis that water contains at all temperatures traces of oxygen and hydrogen not combined, but whose molecules are still sufficiently approximated to exert upon each other a certain attraction. This attraction may then be overcome by an electromotive force inferior to that which theory proves to be required to effect the decomposition of water.

MISCELLANEOUS.

Uniformity of Chemical Analysis.—This question has again been considered by the Chemical Trade Section of the London Chamber of Commerce. The following resolution, passed at the meeting in March, was confirmed on April 28th:—"That (referring to the report of the Analytical Chemists' Sub-Committee of 1884) the margin for divergence be one per cent. In case the difference should be found to be greater, the results should be communicated to both chemists, and, in the event of their not then being able to agree within the limit of one per cent, the sample should be referred to another chemist in accordance with present custom."

NOTES AND QUERIES.

⁂ Our Notes and Queries column was opened for the purpose of giving and obtaining information likely to be of use to our readers generally. We cannot undertake to let this column be the means of transmitting merely private information, or such trade notices as should legitimately come in the advertising columns.

Acetic Acid Plant.—What percentage should be yearly allowed for the depreciation of acetic acid plant, and what for buildings, and what for a boiler?—J.

Zinc-Ethyl.—I have about one ounce of zinc-ethyl in a sealed glass tube. Could any of your readers suggest a safe and easy method of transferring it into a number of smaller sealed tubes for lecture experiments?—Chemicus.

MEETINGS FOR THE WEEK.

Monday, 11th.—Society of Arts, 8. (Cantor Lectures). "The Manufacture of Toilet Soaps," Dr. C. R. Wright, F.R.S.
Tuesday, 12th.—Institution of Civil Engineers, 8.
—— Royal Medical and Chirurgical, 8.30.
—— Photographic, 8.
—— Royal Institution, 3. "Digestion and Nutrition," by Prof. Gamgee.
Wednesday, 13th.—Society of Arts, 8. "A Marine Laboratory as a Means of Improving Sea Fisheries," Prof. E. Ray Lankester.
—— Geological, 8.
—— Microscopical, 8.
Thursday, 14th.—Royal Institution, 3. "Natural Forces and Energies," by Prof. Tyndall.
—— Society of Arts, 8. "The Utilisation of a Natural Chalybeate Water for the Purification of Sewage," Dr. J. C. Thresh.
—— Philosophical Club, 6.30.
Friday, 15th.—Royal Institution. 8. "Cholera," Prof. Burdon Sanderson, at 9.
—— Society of Arts, 8. "The Golden Road to South-Western China," by R. K. Douglas.
—— Royal Institution, 3. "Organic Septics and Antiseptics," Prof. Odling.

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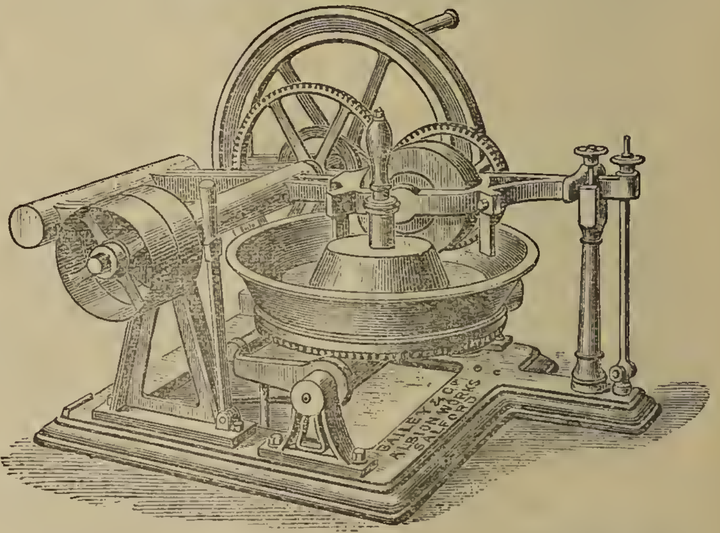

THE CHEMICAL NEWS.

VOL. LI. No. 1329.

DETERMINATION OF FRICTION WITH GASES FLOWING THROUGH PIPES.

By L. C. LEVOIR,
Professor of Applied Chemistry, Technical School, Delft.

WHEN coal-gas flows through a pipe and burns in the air, and one end of the pipe (say 3 feet) can be disconnected in a moment, the flame continues to burn, the air flowing in beneath. The flame burns a shorter time when the tube has a vertical position. When two of such tubes are disconnected mechanically at the same moment, a very small section can be measured by ascertaining the difference of the time of burning of the flames on the two tubes supposed to be of the same length and position to the vertical line. In this way I have demonstrated before a large audience that a chimney in which two matches are burned is a stronger exhauster than the same chimney in which only one is burned. In the same manner I have proved that a chimney with short turns draws less with the same quantity of fuel than a straight one of the same dimensions.

THE QUANTITATIVE DETERMINATION OF TANNIN.

By Dr. F. BECKER.

THE author proceeds as follows:—About 5 grms. methyl-violet are dissolved in 1000 c.c. hot water, and when cold filtered into a bottle which can be closely stoppered; 10 grms. of the purest tannin, well dried, are dissolved in water to 1 litre, and 10 grms. of the sample under examination are also dissolved and made up to 1 litre, the moisture being determined separately. Fifty c.c. of the coloured liquid are poured from a burette into a beaker, and with 450 c.c. water, heated to 50°. The pure tannin solution is then slowly dropped in from a second burette, stirring well, until all the colouring-matter is thrown down. This is ascertained to be the case when a small portion gives a colourless filtrate. If the filtrate is still coloured it is poured back to the bulk, and more of tannin is added. Good paper must be used for filtering, otherwise the liquid passes through turbid. When it has thus been found how much pure tannin is needed to decolourise 50 c.c. of the coloured liquid, the solution of the tannin under examination is treated in the same way, and its relative value is calculated from the figures obtained. This method is also suitable for astringent dye-wares, such as sumach, 20 to 40 grms. being made up to a litre.—*Oester. Gesell. Chem. Industrie* and *Chemiker Zeitung*.

SPECTRUM ANALYSIS OF OILS.

By MM. DOUMER and THIBAUT.

THE fatty oils differ so little from each other physically that their examination is difficult. According to the authors their absortion-spectra enable these oils to be divided into four groups:—1. Those which have the spectrum of chlorophyll, *i. e.*, olive, hemp, and nut oils. 2. Those which transmit all rays equally, and have consequently no spectrum, such as castor oil and the expressed oils of sweet and bitter almonds. 3. Oils which absorb all the "chemical" (more refrangible) rays, and have a characteristic spectrum. On examination it is found that the red, orange, yellow, and half the green regions are unaffected, whilst half the remaining part is absorbed, so that the spectrum suddenly ceases at the green instead of extending to the blue, indigo, and violet. In this group we find rape, colza, mustard, and linseed. The fourth group seems only a modification of the third. The absorption extends in bands over the more refrangible part of the spectrum, but is not complete. In this group we find the oils of sesame, earth-nuts, poppy, and cotton-seed.—*Chemiker Zeitung* and *Les Corps Gras*.

A NEW PROCESS FOR EFFECTING THE LIQUEFACTION OF OXYGEN.

By L. CAILLETET.

LIQUID ethylene when boiling in the free air gives a degree of cold such that oxygen if compressed and cooled to this temperature presents, on diminishing the pressure, a tumultuous ebullition which lasts for an appreciable time.

On quickening the evaporation of the ethlyene by means of the pneumatic machine, as Faraday did for nitrogen monoxide and carbon dioxide, the temperature is lowered so far as to bring the oxygen to a liquid state. The author has endeavoured to avoid the inconvenience and the complication resulting from the necessity of operating in a vacuum. For this purpose he has already proposed the use of liquid formene, which enables us to obtain at once the liquefaction of oxygen and nitrogen. In spite of these advantages, ethylene, which is so easy to prepare and to manage, is preferable to formene, and he has sought to obtain by means of ethylene boiling in open vessels a reduction of temperature sufficient for the complete liquefaction of oxygen. The process employed is exceedingly simple; it consists in intensifying the evaporation of the ethylene by forcing into it a current of air or of hydrogen cooled to an exceedingly low temperature.

In the apparatus employed, the steel receiver which contains the ethylene is fixed to a vertical stand, with its aperture turned downwards. To this aperture is adapted a copper worm of 3 to 4 m.m. in diameter, closed at its lower end by a screw-cock. On cooling the worm to −70° by means of methyl chloride the ethylene which accumulates there has at this temperature a very feeble pressure only, and flows out without sensible loss on opening the exit-cock. This new arrangement, which has been adopted both for ethylene and formene, enables these condensed gases to be cooled, as if the entire reservoir containing them was refrigerated to the temperature of the worm.

The ethylene is received in cylinders of thin glass placed in a glass vessel containing dry air; it is then merely necessary to intensify the evaporation of the ethylene by means of a rapid current of refrigerated air or hydrogen to permit the oxygen condensed in a glass tube to become a colourless liquid, transparent and separated from the stratum of gas above it by a perfectly distinct meniscus.

The author has measured with a hydrogen thermometer, the construction of which will shortly be described, the temperature of the ethylene, which in one of the experiments was found to be −123°. He hopes that by cooling the hydrogen more carefully a lower point may be reached.

The copper worms in which the air and the ethylene circulate are immersed in methyl chloride, which is evaporated rapidly by means of a current of air previously refrigerated.

Finally he has ascertained that on promoting the evaporation of the liquid ethylene by means of a current of air or of hydrogen strongly refrigerated, its temperature may be reduced quite below the critical point of oxygen, which, in this medium, is most distinctly liquefied.—*Comptes Rendus*,

METHOD FOR DETERMINING MANGANESE IN SPIEGELEISEN, FERRO-MANGANESE, AND THE MOST IMPORTANT ORES.

By W. KALMAN and ALAIS SMOLKA.

Manganous oxide when opened up with a flux of borax and potassium-sodium carbonate with access of air yields an oxidation product containing 5 atoms available oxygen and 6 atoms manganese. The flux is obtained by melting in a platinum capsule 2 parts borax glass and 3 parts of the double carbonate, and pulverising the very hygroscopic mass while still warm. There is besides required a solution of ferrous sulphate and a permanganate solution. The former is obtained by dissolving about 100 grms. ferrous sulphate in 1000 c.c. water, acidulating with sulphuric acid, filtering, and mixing the solution with 100 c.c. of pure undiluted sulphuric acid. The permanganate solution is standardised for iron, 1 c.c. of the solution preferably representing 0·0025 grm. iron. Its standard for manganese can be calculated from the following proportion :—iron standard : $x = 10{\cdot}56 : 6{\cdot}55$.

For applying the method from 0·15 to 0·30 grm. of the sample, very finely ground, is ignited for 15 minutes in an open platinum crucible with a Bunsen burner and then more strongly with a blast. By the ignition the manganese is chiefly converted into mangano-manganic oxide. The crucible is let cool, covered, and about 20 parts of the flux weighed in. Heat is slowly applied till the mixture is melted, care being taken that not much spurts up upon the lid, as such portions become oxidised to manganate and make the result too high. The contents of the crucible are kept in a state of fusion for 15 to 20 minutes, the lid is then removed, the crucible placed slanting, and the fusion is continued for 5 minutes longer, stirring with a platinum spoon.

Equal quantities (10 to 15 c.c.) of the iron solution are poured into two beakers and diluted so as to quite cover the crucible. The contents of the crucible are dissolved in the solution in one of the beakers, adding a little strong sulphuric acid if requisite, when the manganese compound formed oxidises a part of the iron. The solution of ferrous sulphate in both glasses is then titrated with permanganate. The difference multiplied by the manganese standard gives the proportion of manganese in the sample. In cases where the manganese exists as a silicate the results are only approximate. It is suitable for all cases where the manganese in the sample may be converted into mangano-manganic oxide by simple ignition, where the proportion of manganese is at least 1 to 2 per cent, and where no other substance is present which can become capable of giving up oxygen to a ferrous solution, such as chorme.—*Monathshefte fur Chemie* and *Chemiker Zeitung*.

A SIMPLE PROCESS FOR SEPARATING ZINC FROM THE REMAINING METALS OF ITS GROUP.

By PROF. W. HAMPE.

As a convenient means for the separation of zinc from iron, nickel, cobalt, manganese, and aluminium, the author recommends the conversion of these metals into formiates, and the treatment of the solution with sulphuretted hydrogen. As far as his experiments extend the zinc is always completely precipitated. The precipitate is always free from manganese and aluminium, and also from nickel, cobalt, and iron, if the solution contains a sufficiency of free formic acid (at least 15 to 20 c.c. of acid of spec. grav. 1·2 in 250 to 500 c.c. of liquid), and those metals are not present in too great excess. In other cases traces of foreign sulphides are sometimes mixed with the zinc hydrosulphide and give it a reddish-brown tint. Iron is most easily thus carried down, nickel and cobalt less readily. These impurities are in quantity very trifling. For their entire removal the precipitate, after filtering and washing, is re-dissolved in nitric acid, supersaturated with ammonia, then with formic acid, and once more precipitated with sulphuretted hydrogen. Such a repetition—certainly not always needed—of the separation would deprive this method of its essential advantages if we had not a means for making zinc sulphide capable of easy and rapid filtration. To this end sulphuretted hydrogen is passed into the hot solution. The zinc sulphide falls as a granular precipitate which filters and washes quickly and clearly. For washing sulphuretted hydrogen water is used to which a little ammonium formiate and formic acid have been added.

On passing sulphuretted hydrogen into the hot solution a little zinc sulphide (about 1 milligramme) is deposited on the sides of the glass so firmly that it cannot be rubbed off. This film, after rinsing the glass, is dissolved off in a little nitric acid, and the solution is added to that of the main precipitate if the precipitation has to be repeated. If this is not necessary, or if the second precipitation is already in process, the nitric solution of the film is mixed with ammonia and ammonium sulphide, then with formic acid until the reaction is acid, and the whole is poured upon the filter to the precipitate, which is already washed.

When dry the zinc-sulphide is not horny and brittle like that thrown down from an acetic solution, but pulverulent, and it can be readily removed from the filter without loss.—*Chemiker Zeitung*,

A METHOD OF FILTRATION BY MEANS OF EASILY SOLUBLE AND EASILY VOLATILE FILTERS.

By F. A. GOOCH.

The processes of analysis, in which it is desirable to re-dissolve precipitates from the filter after washing, or to separate a mixed precipitate into parts by the action of appropriate solvents, are many.

When a complete solution is the object, and the precipitate yields easily to solvents which do not affect paper injuriously, the use of the ordinary filter offers no difficulty. When, however, precipitates are to be treated with reagents which disintegrate paper filters, the case is otherwise; and the attempt to remove, by solvents, any individual part of a mixed heterogeneous mass upon a filter, is always an uncertain matter. As examples of cases of this sort, difficult to deal with, we may take the solution of acid sodic titanate in strong hydrochloric acid; or, the purification of baric sulphate from included salts, by digestion in strong hydrochloric acid; or, the separation of sulphides which are soluble from those which are insoluble in alkaline sulphides; or, the washing out of free sulphur from precipitated sulphides by means of carbon disulphide; or, the separation of calcic and baric sulphates by the action of sodium hyposulphite. In cases of this nature it is often convenient to make use of the asbestos filter which I have previously described;* but this sometimes has its disadvantages. Thus, to recur to the examples just cited, acid sodium titanate may be filtered and washed upon an asbestos filter, and felt and precipitated treated together with hydrochloric acid, but it will be impossible to determine when solution is effected because of the floating asbestos; and in separating the sulphides it would be

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* *Proceedings of the American Academy*, vol. xiii., p. 342.

necessary to know the weight of the asbestos felt, since it must be weighed finally with the insoluble sulphides, unless removed by a special treatment which involves the solution, filtration, and re-precipitation of the latter.

It is to meet cases like these that I have sought a filter which, in the reversal of the ordinary mode of separating filter and precipitate, should dissolve easily in solvents which do not affect the ordinary precipitates met with in analysis. The material which seems best suited to the case—light and fluffy, capable of making secure filters of any desirable degree of porosity, sufficiently insoluble in water and aqueous solutions of salts, alkalies, and acids (excepting strong sulphuric, strong nitric, and glacial acetic acids), easily soluble in naphtha, benzol, carbon disulphide, ether, boiling alcohol, and essential oils, and not too costly—is anthracene.

The mode of preparing and using the filter is simple. Anthracene is slightly moistened with alcohol to make it miscible with water, diluted to the right consistency and applied to the same apparatus, and in the same way, as the emulsion of asbestos which is employed in making asbestos felts. That is to say, enough of the emulsion in water to form a layer of the proper thickness is poured into a perforated crucible which is held tightly in a packing of rubber tubing stretched over a funnel fitted in the usual manner to a vacuum-flask or receiver. After washing with water the filter is ready for use. If the felt happens to be too coarse for the use of the moment, it may be made as close as need be by coating the felt first deposited with a finer emulsion, made by dissolving anthracene in hot alcohol and precipitating with water. When voluminous precipitates are to be filtered, the large perforated cone described in the former paper, to which I have referred, may be substituted with advantage for the crucible; or Cooke's improved form* of Carmichael's process of reverse filtration may prove most useful. In using the cone it is well to apply the anthracene in a thick layer.

To remove the anthracene filter from a precipitate it is only necessary to act with the proper solvent. It is usually convenient to stand the crucible containing precipitate and felt in a small beaker, add enough of the solvent, and gently warm until the anthracene dissolves. On the addition of water, or the reagent to work upon the precipitate, the solution of anthracene floats, and nothing remains to obstruct or obscure the action. If the precipitate dissolves entirely, the solution of anthracene may be separated from the aqueous solution by simply pouring the fluid upon a filter previously moistened with water, when the solution in water runs through, and the anthracene and its solvent remain and may be washed indefinitely with water.

If, on the other hand, the case is one of the division of precipitates, the anthracene and its solvent may be made to pass the filter, after the water has run through, by adding a lttle alcohol to overcome the repulsion between the solution and the water which fills the pores of the filter, the precipitate which stays behind being washed first with a solvent of anthracene, and then, if necessary, with alcohol followed by water; or, if the vacuum filter be used (either paper or asbestos, according to the circumstances of the case), both liquids leave the precipitate and traverse the filter together.

In general, I prefer benzol as the solvent for anthracene, but some advantage may be gained in special cases by a proper choice of solvents. Thus, in removing intermixed sulphur from precipitated sulphides, both the anthracene and the sulphur may be dissolved in carbon disulphide in a single operation.

The ready volatility of anthracene, at a temperature very near its melting-point, 213° C., makes it easily separable in cases when to remove it by a solvent is not advisable. The treatment of a solution of anthracene, for example, with strong sulphuric or nitric acid, is apt to produce carbonaceous or gummy residues. In such cases it is well either to heat precipitate and filter directly, or to first remove them from the crucible by means of a solvent for anthracene, then evaporate this and raise the heat gently until the anthracene has vanished. The purification of precipitated baric sulphide, by dissolving it in hot, strong sulphuric acid, and re-precipitating by dilution, is a case in point; and one, too, in which the reversed filter may be used with great advantage. It may be remarked, in passing, that, if one does not happen to possess a platinum rose, and does happen to have at disposal a perforated crucible, a very fair reversed filter may be improvised of the crucible, a piece of glass tubing, and a rubber stopper, the last being fitted to the crucible, and the tube passed through nearly to the perforated bottom.

At every point in the preparation and use of the anthracene filter I have found the manipulation peculiarly easy.—*Proceedings of the American Academy*, March 11, 1885.

NOTE WITH REFERENCE TO THE METHODS PROPOSED FOR COKING COAL AND RECOVERING VOLATILE MATTERS.*

By HENRY E. ARMSTRONG, F.R.S.,
Professor of Chemistry in the City and Guilds of London Institute, Central Institution.

The subject of the recovery of volatile matters expelled in coking coal has attracted much attention during recent years, and has been brought prominently under the notice of the Iron and Steel Institute by the papers read by Mr. Simon in 1880, Mr. Dixon and Mr. Jameson in 1883, and Mr. Watson Smith in 1884. In this note I do not propose to directly criticise what has been said, nor do I wish to appear as advocate of any one in particular of the several forms of plant which have been devised for the recovery of by-products in the coking of coal; but I would crave permission to call attention, from a somewhat theoretical point of view, to considerations which a careful study of the literature of the subject, as well as of the "tars" obtained under a variety of conditions, and experience gained during a prolonged investigation of the products of the oil-gas manufacture, have led me to think should receive attention if we are to arrive at a satisfactory solution of the problem at issue: which is none less than the as complete recovery as possible from coal of the matters latent in it in the most economical and advantageous manner and form.

It is perhaps not undesirable in the outset to emphasize the fact that something more is necessary than the mere collection of the volatile matters given off in coking coal, and that this is the case because, even if the operation be always so conducted as to furnish coke of good quality, the quantity and character of the volatile products will vary within very wide limits for each particular class of coal according to the conditions under which coking is effected. The results obtained by Mr. Watson Smith in his comparative examination of the tar from the Simon-Carvès and Jameson ovens and from the Gartsherrie blast furnaces afford ample proof of this.

From a chemical point of view, we at present know practically nothing of the composition of coals; in fact, we have hitherto been satisfied to determine merely their percentage composition. It is in the highest degree probable, however, that coals, especially those of the bituminous class, for the most part consist of highly complex compounds which, to a large extent, are not the mere residues of the primeval vegetation preserved to us as coal, but have resulted from the occurrence during the lapse of ages of a variety of complex chemical changes. These compounds, I believe, are mainly of two kinds: *phenolic compounds*, which are the primary source of the

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* *Proceedings of the American Academy*, vol. xii., p. 124.

* Read before the Iron and Steel Institute.

phenols (carbolic acid, &c.), contained in coal-tar; and *paraffinoid compounds*, capable of yielding hydrocarbons such as are obtained on distilling shale. There can be little doubt that the compounds present in ordinary *high-temperature* tars, such as are obtained in manufacturing coal-gas and in Simon-Carvès tar, are not, for the most part, immediate products of distillation, but that they are formed from the immediate products of distillation by a great variety of secondary chemical changes—changes which in part are of an analytical and in part of a synthetical character. Tars such as have been obtained from the Jameson oven and the Scotch blast-furnaces, on the other hand, I believe more nearly represent the primary products of distillation of coal, and I am convinced that they are to be regarded as low temperature products.

Ordinary coal-tars contain but a very small proportion of what may be termed shale products; they are characterised by the presence of a great variety of "benzenoid" hydrocarbons, such as benzene, toluene, xylene, naphthalene, and anthracene; and relatively to cresols and other higher phenols, phenol (carbolic acid) itself is present in large amount. The Simon-Carvès tar is said to closely resemble ordinary coal-tar. The Jameson tars, on the other hand, are exceedingly rich in paraffinoid hydrocarbons, such as occur in shale-oil; but I have succeeded in separating from them only the merest traces of naphthalene, a very small quantity of xylene, but neither benzene nor toluene; my results being entirely confirmatory in this respect of those published by Mr. Watson Smith. The Jameson tars, however, contain a not inconsiderable proportion of higher hydrocarbons of the benzene series not yet discovered in coal-tar, and which, in fact, could not survive the ordeal of high temperature to which coal-tar is subject. The percentage of phenols is very high, but, as Mr. Watson Smith has pointed out, phenol itself is almost entirely absent; paracresol is present in considerable amount, together with other homologues of phenol.

Coal-tar is chiefly of value as a source of benzene, toluene, xylene, naphthalene, anthracene, and phenol; these are absent from the Jameson tars, which cannot be satisfactorily treated as shale-oil; as the proportion of solid paraffin in them is not large; while the amount of phenols other than phenol itself is considerable. Jameson tar, therefore, is of no immediate use except as a creosoting material. The Simon-Carvès tar is stated to be equal in value, if not superior, to ordinary coal-tar; there is, however, a great want of reliable information on this point. Still, the opinion appears to be gaining ground that the Simon-Carvès tar is a satisfactory product, because it resembles coal-tar; and that the Jameson tar is an unsatisfactory product because it is not at all like coal-tar, and contains little that is of immediate value. Consequently, the Simon-Carvès oven has been vigorously advocated as affording a solution of the problem under consideration.

I venture to demur to this, and even to assert that, at all events from a chemist's point of view, the method followed in coking coal in the Simon-Carvès oven is irrational in comparison with that followed when coking is performed in the beehive oven as modified by Jameson. Coal-tar always was, and still is, a mere by-product of the manufacture of coal-gas, and, in producing it, no attempt whatever is made to secure a product having special qualities; it therefore by no means follows that, because we obtain a product equal in value, or even slightly superior, to ordinary coal-tar in coking coal, we have got the best product which it is possible to obtain from the material at disposal, or that, in obtaining this product under such conditions, much that is valuable has not been lost. Moreover, coal-tar is what may be termed a *final product*; it cannot well be dealt with in any way so as to improve its quality. The Jameson oil, however, although perhaps of no great immediate value, is not a final product, since it *can* be dealt with so as to improve its quality; by passing it through red-hot retorts, it may be made to yield a considerable quantity of very rich illuminating gas, and a large proportion of benzene and other valuable products, such as are present in ordinary coal-tar. In an experiment on a fairly large scale with Jameson tar at the Great Eastern Railway Co.'s Oil-Gas Works, a very satisfactory yield of gas was obtained, considering the crude character of the material used (see my paper on the oil-gas manufacture, *Journal of the Society of Chemical Industry*, 1884).

Illuminating gas is made in this country, as heretofore, from coal. The plant has undergone great improvements, and the yield of gas has been much increased by the almost universal adoption of clay retorts, which has made it possible to distil the coal at a much higher temperature; but this has been done at the expense of quality, and in this respect the public would be distinctly worse off than twenty years ago, were it not for the great improvements effected in gas-burners. I believe the present mode of making illuminating gas to be by no means a rational one: owing to the character of the material used, the charging and discharging of the retorts is an operation of considerable difficulty; the yield of gas is very small in proportion to the amount of coal carbonised; the gaseous product is poor in quality, owing to the very high temperature which prevails in the retorts; the coke is also of low quality, and the operation is so conducted that the quality of the tar is practically beyond control. Sooner or later the public must become aware how inferior an article is supplied by the gas companies, and will demand something far better, which they can use in much smaller quantity, and thereby materially diminish the evils arising from the domestic use of gas as an illuminant. Or if the public do not become educated on this question, competition with the electric light will do much to force on improvements. Lastly, the impossibility of laying down mains adequate to carry sufficient gas to supply the demands arising from the general use of gas for heating purposes and in gas engines will also necessitate a radical modification of the present unscientific system of manufacture, so as to obtain a less bulky gas; for it is in this direction, I believe, and not in that advocated by Sir W. Siemens, that we must expect improvements to take place. Probably oil will then be largely used in the manufacture of gas, and we may expect to see the introduction of some such process as that which is rapidly being adopted in town after town in the United States. Oil suitable for this purpose, I believe, could well be obtained by distilling coal at as low a temperature as possible.

The Simon-Carvès oven may be exceedingly good as a coke oven; that is, it may give a large yield of coke of high quality; but it appears to me to be irrationally constructed in two respects. Firstly, because the heat is applied externally, and therefore more or less wastefully. Secondly, because the mass of coal is first heated to redness on its exterior, and all the products of distillation are then neccessarily forced to pass through a red-hot carbonaceous shell, thus giving opportunity for the occurrence of a great variety of chemical changes, many of which tend to deteriorate the product. In the Jameson oven this is avoided, and the immediate products of distillation are not subject to the same fiery ordeal. My idea of a theoretically perfect coke oven is somewhat as follows. It would consist of an oven more or less like the present beehive, but with the upper part largely extended so as to form a furnace chamber of the type advocated by Mr. F. Siemens. Heat would be *radiated* upon the surface of the charge of coal which would soon become coked, thus forming a protecting layer below which distillation would take place, the products being sucked away as rapidly as possible, and at as low a temperature as possible through the cool bottom of the oven. As slight an excess of air as possible, if any excess, being admitted to the furnace above, the small proportion of products of combustion which penetrated the upmost layer would carry no oxygen with them. On this account, and because of the large volume of steam and of other gases generated within the mass, and because of the low temperature, the ammonia would probably almost entirely escape destruction. The gas sucked away would be of low quality as an illuminating gas, and would be available for carbonising, oil and ammonia having been removed from it by efficient scrubbing. Whether this idea can be realised in practice I cannot decide, but I would not hesitate to attempt its realisation if I were in the position to do so.

Finally, let me again point out that we know practically nothing of what happens when coal is distilled, or of the conditions most favourable to the production of the valuable constituents of tar. Until we possess adequate knowledge on these points, the coking of coal and the manufacture of gas from coal and oils are empirical operations, and cannot be conducted scientifically. It would not be difficult to gain the required information, but the aid of the chemist must be sought and the experiments must be on a moderately large, and therefore expensive, scale. Our private dabbling with tars from various sources can never lead to a really satisfactory result. The interests involved are so great, the subject is one of such national importance, that failure to initiate and execute the necessary systematic experiments without further loss of time is simply inexcusable.

A CATALOGUE OF CHEMICAL PERIODICALS.*

By H. CARRINGTON BOLTON, Ph.D.,
Professor of Chemistry in Trinity College, Hartford, Conn.

(Continued from p. 218).

Explanation of Signs.

+ Following a date signifies current at the date in question.
|| Following a date signifies publication discontinued.

Bastick (W.) and Dickenson (W.).
See Annals of Pharmacy and Practical Chemistry.

Beiblätter zu den Annalen der Physik und Chemie.
See Journal der Physik.

Beilstein's Zeitschrift für Chemie.
See Kritische Zeitschrift für Chemie.

40. Beiträge zur Chemie in Uebersetzung oder vollständigen Auszügen neuer chemischer Abhandlungen, sammt einigen neuen Aufsätzen. Herausgegeben von F. A. X. von Wasserberg. 1 vol., 8vo. Wien, 1791.

Beiträge zur Chemie und Physik, von J. S. C. Schweigger
See Allgemeines Journal der Chemie.

41. Beiträge zur chemischen Kenntniss der Mineralkörper. Herausgegeben von M. H. Klaproth. 6 vols., 8vo. Berlin und Stettin, 1795-1815.

42. Beiträge zur Erweiterung und Berichtigung der Chemie. Herausgegeben durch C. F. Bucholz. 3 vols., 8vo. Erfurt, 1799-1802.

43. Beiträge zur physiologischen und pathologischen Chemie und Mikroscopie in ihrer Anwendung auf die praktische Medicin, unter Mitwirkung der Mitglieder des Vereins für physiologische und pathologische Chemie und anderer Gelehrten, herausgegeben von Franz Simon. 1 vol., 8vo. Berlin, 1843.

Continued under the title:

[a] Archiv für physiologische und pathologische Chemie und Mikroscopie in ihrer Anwendung auf die praktische Medicin. Organ für die Fortschritte der gesammten medicinischen Chemie im In- und Auslande. Unter Mitwirkung mehrerer Gelehrten des In- und Auslandes als Fortsetzung der von Franz Simon in Berlin gegründeten Zeitschrift "Beiträge, etc.," herausgegeben und redigirt von J. F. Heller. 4 vols. (I.-IV.), 8vo. Wien und Berlin, 1844-'47.

Continued under the title:

[b] Archiv für physiologische und pathologische Chemie und Mikroscopie mit besonderer Rücksicht auf die medicinische Diagnostik und Therapie. Herausgegeben von Joh. Florian Heller. Neue Folge. 2 vols., (V.-VI.), 8vo. Wien, 1852-'54-||

Bennewitz, Paul.
See Deutscher Chemiker-Kalender; *also* Technisch-chemischer Kalender.

Bergé, Henri.
See Chimiste (Le).

44. Berichte der deutschen chemischen Gesellschaft. 17 vols. [*from* 1874 *each volume in two parts*], 8vo. Berlin, 1868-'84+

Generalregister über die ersten zehn Jahrgänge 1868-1877) der Berichte der deutschen chemischen Gesellschaft zu Berlin. Bearbeitet von C. Bischoff. 1 vol., 8vo. Berlin, 1880.

Berlin, Deutsche chemische Gesellschaft.
See Berichte der deutschen ——.

(To be continued).

PROCEEDINGS OF SOCIETIES.

CHEMICAL SOCIETY.

Thursday, May 7th, 1885.

Dr. H. Müller, F.R.S., President, in the Chair.

Certificates were read for the first time in favour of Messrs. Joseph Fearon Burnett, 23, Alma Square, N.W.; Alfred Daniel Hall, B.A., Baliol College, Oxford; T. Vaughan Hughes, Holywell, N. Wales; Francis George Newbolt, Baliol College, Oxford; Thomas Goddard Nicholson, All Saints' Street, Norwich; Duncan Scott, Macnair, Cliff Edge, Higher Broughton, Manchester; William Hugh Spottiswoode, 4, Grosvenor Place, S.W.; Charles Johnson Taylor, M.A., Toppesfield Rectory, Halstead, Essex; and Robert Wallace, Royal Agricultural College, Cirencester.

The following were elected Fellows of the Society:—

Messrs. F. H. Alcock, M. Cannon, M. Dechan, H. Follows, H. M. Freear, G. H. Gemmell, F. A. Genth, jun., G. M. Gregory, W. B. Hards, E. G. Hogg, C. F. Hope, F. R. Mallet, N. H. J. Miller, A. Milne, T. Muskett, W. H. Reid, R. E. Steel, C. M. Stuart, J. A. Tate, and W. P. Wynne.

The following papers were read:—

37. "*On some Points in the Composition of Soils; with Results illustrating the Sources of Fertility of Manitoba Prairie Soils.*" By Sir J. B. Lawes, Bart., LL.D., F.R.S., F.C.S., and J. H. Gilbert, Ph.D., LL.D., F.R.S., V.P.C.S.

This paper is a continuation of one given by the authors at the meeting of the American Association, held at Montreal in the autumn of 1882, entitled "Determinations of Nitrogen in the Soils of some of the Experimental Fields at Rothamsted, and the Bearing of the Results on the Question of the Sources of the Nitrogen of our Crops."

The first part of the present paper consists of a *resumé* of the previous one. It was there shown that when crops are grown year after year on the same land without nitrogenous manure, the produce and the yield of nitrogen decline in a very marked degree. This is the case even when a full mineral manure has been applied; and it is

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* Advance-proofs from the *Annals of the New York Academy of Sciences.*

the case not only with cereals and with root-crops, but also with Leguminosæ. Further, with this great decline in the annual yield of nitrogen of these very various descriptions of plant, when grown without artificial nitrogenous supply, there is also a marked decline in the stock of nitrogen in the soil. Thus a soil-source of, at any rate, some of the nitrogen of the crops was indicated. Other evidence was also adduced clearly pointing to the same conclusion.

Next, that determinations of the amounts of nitrogen as nitrate in soils of known history as to manuring and cropping, and to a considerable depth, show that the amount of nitrogen in the soil in that form is much less after the growth of a crop than under corresponding conditions without a crop. It was hence concluded that nitrogen had been taken up by the plant as nitrate. In the case of gramineous crops, and some others, the evidence points to the conclusion that most, if not the whole, of the nitrogen is so taken up from the soil. It is also clear that some, at any rate, of the nitrogen of Leguminosæ has the same source; and the results are in favour of the supposition that in some of the cases the whole of it might be so accounted for. Still it is admitted that, in other cases, this seemed doubtful.

The conditions and the results of a large number of new experiments are next described. It is found that there is very much more nitrogen as nitrate, in soils and subsoils, down to the depth of 108 inches, where leguminous than where gramineous plants have grown. The results point to the conclusion that under the influence of leguminous growth and crop-residue, especially in the case of strong and deep-rooted plants, the conditions are more favourable for the development and distribution of the nitrifying organism; and if this view be confirmed, an important step would be gained towards the more complete explanation of the sources of the nitrogen of the Leguminosæ, which assimilate a very large quantity of nitrogen, inducing, as above supposed, the nitrification of the nitrogen of the subsoil, which may thus become the source of the nitrogen of such crops. An alternative obviously is, that the plants might still take up nitrogen from the subsoil, but as organic nitrogen, and not as nitrate. There is, however, no direct experimental evidence in favour of such a view, whilst some physiological considerations, which are discussed, seem to be against it. Again, results show that the soil and subsoil contain less nitrogen as nitrate after the growth of good crops of *Vicia sativa* than where the more shallow-rooted *Trifolium repens* fails to grow. This is further evidence that the Leguminosæ take up nitrogen as nitrate; and in the experiments in question the deficiency of nitric nitrogen in the soil and subsoil of the *Vicia sativa* plots, compared with the amount in those of the *Trifolium repens* plot to the depth examined, is sufficient to account for a large proportion of the nitrogen estimated to be contained in the *Vicia* crops.

Other experiments are quoted which bear less directly on the point, the results of which are, however, accordant; and they at the same time afford illustrations of the loss of nitrogen that the land may sustain by fallow in a wet season, and therefore of the benefits arising from the ground being covered with a crop which takes up the nitrate as it is produced. To conclude on this part of the subject, it may be considered established that much, at any rate, of the nitrogen of crops is derived from the stores within the soil, and that much, and in some cases the whole, of the nitrogen so derived is taken up as nitrates.

This leads the authors to the consideration of the second part of their subject, namely, the sources of fertility of some Manitoba prairie soils.

Soils from Portage la Prairie, from the Saskatchewan district, and from near Fort Ellice, were first examined. They proved to be about twice as rich in nitrogen as the average of arable soils in Great Britain, and perhaps about as rich as the average of the surface soil of permanent pasture land.

Four other Manitoba soils were examined in greater detail. One was from Niverville, 44 miles west of Winnipeg, the second from Brandon, the third from Selkirk, and the fourth from Winnipeg itself. These soils show a very high percentage of nitrogen; that from Niverville nearly twice as high a percentage as in the first 6 or 9 inches of ordinary arable land, and about as high as in the surface soil of pasture land in Great Britain. The soil from Brandon is not so rich as that from Niverville; still the first 12 inches of depth is as rich as the first 6 or 9 inches of good old arable lands. The soil from Selkirk shows an extremely high percentage of nitrogen in the first 12 inches, and in the second 12 inches as high a percentage as in ordinary pasture surface soil. Lastly, both the first and second 12 inches of the soil from Winnipeg are shown to be very rich in nitrogen; richer than the average of old pasture surface soil.

The question arises—how far the nitrogen in these soils is susceptible of nitrification and so of becoming easily available to vegetation. The soils and subsoils were placed in shallow dishes, covered with plates of glass, kept under proper conditions of temperature and moisture for specified periods, extracted from time to time, and the nitric nitrogen determined in the extracts.

The periods were never less than twenty-eight days, and sometimes more. The rate of nitrification declined after the third and fourth periods. There was a very marked increase in the rate of nitrification in the subsoils during the eighth period compared with the seventh, there having been added only as much as a tenth of a gram of garden soil containing nitrifying organisms. This result is of much interest, affording confirmation of the view that the nitrogen of subsoils is subject to nitrification, if only under suitable conditions, and that the growth of deep-rooted plants may favour nitrification in the lower layers.

Records show that the rich prairie soils of the North-west are competent to yield large crops; but under existing conditions they certainly do not on the average yield amounts at all commensurate with their richness compared with the soils of Great Britain, which have been under arable cultivation for centuries. That the rich prairie soils do not yield more produce than they do, is due partly to climate, but largely to scarcity of labour, and consequent imperfect cultivation, and too luxuriant a growth of weeds; and until mixed agriculture, with stock feeding, can be had recourse to, and local demand arises, the burning of the straw, and deficiency or waste of manure, are more or less inevitable, but still exhausting practices. So long as land is cheap and labour dear some sacrifice of fertility is unavoidable in the process of bringing these virgin soils under profitable cultivation; and the only remedy is to be found in increase of population. Still the fact should not be lost sight of, that such practices of early settlement, however unavoidable, do involve serious loss of fertility.

A table has been prepared showing the comparative characters, as to percentage of nitrogen and carbon, of exhausted arable soils, of newly laid down pasture, and of old pasture soils, at Rothamsted; also of some other old arable soils in Great Britain; of some Illinois and Manitoba prairie soils; and lastly, of some very rich Russian soils. A comparison of the figures leaves no doubt that a rich virgin soil, or a permanent pasture surface soil, is characterised by a relatively high percentage of nitrogen and carbon. On the other hand, soils which have long been under arable culture are much poorer in these respects; whilst arable soils under conditions of known agricultural exhaustion show a very low percentage of nitrogen and carbon, and a low relation of carbon to nitrogen.

In conclusion, the authors said it had been maintained by some that a soil was a laboratory and not a mine; but not only the facts adduced by them in this and former papers, but the history of agriculture throughout the world, so far as it was known, clearly show that a fertile soil is one which had accumulated within it the residue of ages of previous vegetation; and that it became infertile as this residue was exhausted.

38. "*Researches on the Relation between the Molecular Structure of Carbon Compounds and their Absorption Spectra.*" By Professor W. N. Hartley, F.R.S.

In continuation of the author's previous researches (*Trans.*, 1881, 57—60 and 111—128; 1883, 676—678), measurements have been made of the wave-lengths of the rays absorbed by the following substances:—

1. Aromatic hydrocarbons: benzene, the three xylenes, and naphthalene.
2. Aromatic tertiary bases and their salts: pyridine, picoline, quinoline, and their hydrochlorides.
3. Addition products of tertiary bases and salts: piperidine, tetra-hydroquinoline and its hydrochloride.
4. Primary aromatic bases or amido-derivatives and salts thereof: ortho- and para-toluidine and their hydrochlorides.

In the preparation of solutions, a milligram-molecule, that is, the molecular weight in milligrms., was dissolved in 20 c.c. of a diactinic solvent, and made up to a given volume, generally 20 c.c. In this way molecular weights were made to occupy equal volumes. Photographs of the absorption spectra were taken through definite thicknesses of solution. The lines of tin, lead, and cadmium were used as references; the positions of the bands were measured on the photographs by means of an ivory rule divided into hundredths of an inch, and those measurements were reduced by means of two curves to oscillation frequencies and wave-lengths. As far as possible, the absorption curves are drawn to a uniform scale. These curves indicate the *molecular actinic absorption* of each substance.

The following deductions are drawn:—

When an atom of nitrogen is substituted for an atom of carbon in the benzene or naphthalene nucleus, the property of selective absorption is still retained.

When the condensation of the carbon and nitrogen in the molecule of a benzenoid compound or tertiary base is modified by the addition of an atom of hydrogen to each atom of carbon and nitrogen, the power of selective absorption is destroyed.

When the condensation of the carbon in quinoline is modified by the combination therewith of four atoms of hydrogen, the intensity of the selective absorption is reduced and is not destroyed.

A very pure specimen of quinoline from coal-tar gave an absorption curve identical with that of quinoline prepared synthetically by Skraup's method. It may further be added that molecular actinic absorption of a salt is different from that of the organic base which it contains, although the acid exerts no absorptive power by itself. Sometimes the difference is very great, but the area included by the curve of the salt is always less than that of the base. Molecules vibrate as wholes or units, and the fundamental vibrations give rise to secondary vibrations which stand in no obvious relation to the chemical constituents of the molecule, whether these be atoms or smaller molecules. Hence it appears that a molecule is a distinct and individual particle which cannot be truly represented by our usual chemical formulæ, since these only symbolise certain chemical reactions and physical properties, and fail to express any relation between physical and chemical properties.

39. "*Researches on the Action of the Copper-zinc Couple on Organic Bodies.*" Part X. Benzyl Bromide. By Dr. J. H. Gladstone, F.R.S., and Alfred Tribe.

The authors have extended their previous researches on the action of the copper-zinc couple on organic bodies to compounds of the aromatic series. Ortho- and para-bromotoluene are not attacked by the couple, but the isomeric benzyl bromide, C_7H_7Br, is very readily acted upon. So rapid, indeed, is the action, that it is necessary to operate with only very small quantities at a time. Some bromide of zinc is formed, but the main products are bromhydric acid and two apparently different resin-like bodies, the one soluble and the other insoluble in ether, which become viscid at a little above the ordinary temperature, and are decomposed on distillation. Though no specimen was obtained pure, combustions indicated that they were hydrocarbons of the empirical composition C_7H_6, and this was supported by evidence derived from their specific refraction and dispersion. It is proposed to name them α- and β-benzylene. The bromo- and nitro-compounds are uncrystallisable bodies.

In the presence of ether the reaction is very different. The zinc is dissolved in a larger proportion than would be necessary to form $ZnBr_2$; in fact, the proportion of zinc to bromine is very constantly 1 : 1·6. The organic zinc compound was not isolated, but it is decomposed by water with the formation of zinc hydroxide, zinc bromide, and toluene. When the compound is strongly heated, dibenzyl also separates from it.

In the presence of absolute alcohol the reaction takes another form. Toluene, C_7H_8, is produced, and a bromo-zinc organic compound, doubtless bromoethylate of zinc, $ZnBr.OC_2H_5$. Some dibenzyl was also formed.

In the presence of water the action was slow at the ordinary temperature. The benzyl bromide was found to be mainly resolved into dibenzyl and zinc bromide, but some toluene and zinc oxybromide were also produced.

One or two other compounds formed in smaller quantities were partially examined, but the investigation was not carried further on account of the extremely noxious character of the vapour of the original substance.

40. "*On the Selective Alteration of the Constituents of Cast Iron.*" By Thomas Turner, Assoc. R.S.M.

The paper contains an account of some experiments undertaken with a view of removing manganese from a sample of silicon pig iron containing Silicon, 9·80; Manganese, 1·95; Total carbon, 1·81.

The iron was fused with various substances and the resulting metal analysed. Since manganese is more readily oxidised than iron, it was expected that ferrous silicate would have removed the manganese, leaving the other constituents unchanged. It was found, however, that ferrous silicate produced no alteration in the relative amounts of silicon and manganese present.

Other materials were employed, rich either in silica or oxide of iron, and the author concludes that the active agent in the oxidation of manganese is ferric oxide: that it is not possible by either of the methods employed to remove one constituent without materially altering the amounts of the others present; and that iron of a definite composition may be best obtained by starting with a pure metal and adding the desired constituents.

41. "*On the Existence of Nitrous Anhydride in the Gaseous State.*" By Prof. G. Lunge.

The experiments made by Ramsay and Cundall on this point are not conclusive, as their methods are not free from objections, and the argument based upon the determination of vapour-densities is a very uncertain one in this case. On the other hand, the author has long ago furnished proof of the existence of N_2O_3 as gas, by showing that a vapour possessing that composition is only partially converted into N_2O_4, even when mixed with a tenfold excess of oxygen, and at temperatures ranging between 4° and 150° C. When liquid N_2O_3 evaporates, partial dissociation certainly takes place, but only to a comparatively small extent. This view is also supported by the researches on the vitriol-chamber process, latterly made by the author in conjunction with Naef.

42. "*On the Reaction between Nitric Oxide and Oxygen under varying Conditions.*" By Prof. G. Lunge.

Experimental evidence is given for the following conclusions:—

1. That when nitric acid is mixed in the dry state with

an excess of oxygen they combine exclusively, or nearly so, to form N_2O_4.

2. Dry NO and O_2, with an excess of the former, yield a large proportion of N_2O_3 along with N_2O_4, both in the state of gas.

3. In the presence of water, NO in the presence of an excess of O_2 is altogether converted into HNO_3.

4. If NO and O_2 meet in the presence of concentrated sulphuric acid, neither N_2O_4 nor HNO_3 is formed, even with the greatest excess of oxygen; but the reaction is:—

$$4SO_4H_2 + 4NO + O_2 = 4SO_2(OH)(ONO) + 2H_2O.$$

The bearing of these facts on the theory of the vitriol-chamber process is then discussed. The author considers that N_2O_3, and not NO as hitherto assumed, is the carrier of oxygen, and that as long as any appreciable quantity of SO_2 is present, no nitric oxide is formed, the following being the reactions whereby the sulphuric acid is formed:—

$$2SO_2 + N_2O_3 + O_2 + H_2O = 2SO_2(OH)(O_2N)$$
$$2SO_2(OH)(O_2N) + H_2O = 2SO_2(OH)_2 + N_2O_3.$$

DISCUSSION.

Dr. Armstrong said that he had always been of opinion that Prof. Lunge's experiments could not be accepted as establishing the existence of N_2O_3 as gas. The fact that NO acts upon nitric acid in presence of sulphuric acid, reducing it to the nitrous state, vitiates the results in those cases in which the gases were passed into sulphuric acid, the amount of nitric and nitrous nitrogen in the solutions thus obtained being then determined. Lunge admits that NO does so act, and yet continues to employ the method. It is unimportant whether or no the action be readily effected to the full extent; if such an action take place at all, the method is necessarily faulty, and therefore inapplicable to the differentiation of mixtures of N_2O_4 with NO from N_2O_3. Lunge's experiments described in *Dingl. polyt. J.*, ccxxxiii., 68, are not only subject to this criticism, but it is also probable that with the arrangement he employed the gases never became thoroughly mixed; on passing NO and air through a similar apparatus, Dr. Armstrong had found this actually to be the case. Lunge and Naef's observations on the composition of the chamber gases were a complete riddle to him. It appeared almost incredible that the oxidised nitrogen could exist entirely as N_2O_3, in presence of a large excess of oxygen, SO_2 and NO being absent. Experiments on the behaviour of NO towards oxygen in presence of third bodies, however valuable in themselves, could not be accepted as throwing any light on the question at issue.

PHYSICAL SOCIETY.

May 9th, 1885.

Prof. Guthrie, President, in the Chair.

The Meeting was held in the Physics Theatre of Clifton College, Bristol, in consequence of an invitation from the British Naturalists' Society. Messrs. E. Cleminshaw, E. F. Herrom, and A. L. Selby were elected members of the Society.

The following communications were read:—

"*On Evaporation and Dissociation*," by Prof. W. Ramsay and Dr. S. Young. The authors gave the results of a series of investigations undertaken with the view of determining how far the passage of a liquid into a gas resembled the dissociation of a chemical compound. For this purpose the relation between the pressure and temperature of several dissociating substances, such as ammonic carbonate, chloral hydrate, and phthalic acid, had been examined. The authors hope shortly to publish the full details of these experiments and the conclusions arrived at.

"*On a Model illustrating the Propagation of the Electro-magnetic Wave*," by Dr. S. P. Thompson. The model consists of two sets of beads. Each set is composed of a number of beads fixed to the extremities of wires, and by a suitable mechanical contrivance each executes an approximately harmonic motion at right angles to the wires and the mean plane of the set. The phase of each bead differing by a certain small amount from the succeeding, the whole represents a wave propagation. The two sets are coloured differently and are so placed that their harmonic motions are executed at right angles about the same axis which represents the direction of propagation of an electro-magnetic disturbance, one wave being the electro-static and the other the electro-magnetic displacement.

"*On a Self-recording Stress and Strain Indicator*," by Prof. H. S. H. Shaw. This instrument was designed for one of Wicksteed's 50-ton single lever machines lately erected in the engineering laboratory of University College, Bristol, and has been found very simple and effective. In this testing machine the stress is applied by moving a mass of one ton along a lever; this mass is connected by a cord with a vertical cylinder upon the indicator. This cylinder carries a paper wound round it, and turns upon its axis as the mass is moved towards the end of the lever. A pencil capable of a vertical motion bears against this, and thus horizontal distances upon the paper are measures of stress. The strain is measured by the vertical motion of the pencil, the position of which is controlled by a wire attached to the rim of a wheel above, upon the same axis of which are other smaller wheels, any one of which can be connected to a fine wire which is carried horizontally to the upper end of the test piece, passing over a pulley fixed to it and is fixed to the lower end. Any extension of the test piece can be multiplied at pleasure on the diagram by attaching the wire to a larger or smaller wheel.

"*Note on the so-called Silent Discharge of Ozone-Generators*," by W. A. Shenstone. Mr. Shenstone had arranged some apparatus by which this could be viewed. It seemed to have the characteristics of the Brush discharge.

ROYAL INSTITUTION OF GREAT BRITAIN,

Annual Meeting, Friday, May 1, 1885.

The Duke of Northumberland, D.C.L., LL.D., President, in the Chair.

The Annual Report of the Committee of Visitors for the year 1884, testifying to the continued prosperity and efficient management of the Institution, was read and adopted. The Real and Funded Property now amounts to above £85,400, entirely derived from the Contributions and Donations of the Members.

Forty-four new Members paid their Admission Fees in 1884.

Sixty-three Lectures and Twenty Evening Discourses were delivered in 1884.

The Books and Pamphlets presented in 1884 amounted to about 276 volumes, making, with 506 volumes (including Periodicals bound) purchased by the Managers, a total of 782 volumes added to the Library in the year.

Thanks were voted to the President, Treasurer, and the Honorary Secretary, to the Committee of Managers and Visitors, and to the Professors, for their valuable services to the Institution during the past year.

The following Gentlemen were unanimously elected as Officers for the ensuing year:—

President—The Duke of Northumberland, D.C.L., LL.D.

Treasurer—George Busk, Esq., F.R.S.

Secretary—Sir Frederick J. Bramwell, F.R.S.

Managers—Sir Frederick Abel, C.B., D.C.L., F.R.S.; George Berkley, Esq., M.I.C.E.; Sir William Bowman, Bart., LL.D., F.R.S.; Joseph Brown, Esq. Q.C.; William Crookes, Esq., F.R.S.; Warren de la Rue, Esq., M.A., D.C.L., F.R.S.; Captain Douglas Galton, C.B., D.C.L., F.R.S.; The Hon. Sir Wm. Robt. Grove, M.A., D.C.L., LL.D., F.R.S.; Sir J. D. Hooker, K.C.S.I., C.B., M.D., D.C.L., LL.D., F.R.S.; William Huggins, Esq., D.C.L., LL.D., F.R.S.; Hugo W. Müller, Esq., Ph.D., F.R.S.; The Right Hon. Earl Percy, M.P.; Henry Pollock, Esq.; John Rae, M.D., LL.D., F.R.S.; The Right Hon. Lord Rayleigh, M.A., D.C.L., F.R.S.

Visitors—The Lord Brabazon; Stephen Busk, Esq., Arthur Herbert Church, Esq., M.A.; Frank Crisp, Esq., LL.B., B.A., F.L.S.; Henry Herbert Stephen Croft, Esq., M.A; Rear-Admiral Herbert P. De Kantzow, R.N.; William Henry Domville, Esq.; Alfred Gutteres Henriques, F.G.S.; Rev. John Macnaught, M.A.; Robert James Mann, M.D., F.R.C.S.; John W. Miers, Esq.; William Henry Preece, Esq., F.R.S.; Lachlan Mackintosh Rate, Esq., M.A.; William Chandler Roberts, Esq., F.R.S., Basil Woodd Smith, Esq. F.R.A.S.

UNIVERSITY COLLEGE, LONDON,

Chemical and Physical Society.

Thursday, May 7, 1885.

C. E. Cassal, F.I.C., F.C.S., President, in the Chair.

"*Some Experiments on Induction*," by Dr. A. H. Fison. The experiments consisted in measuring the rate at which induced currents died away in a metallic mass. A Morse key was so arranged in circuit with an induction coil and galvanometer that when the key was up the primary circuit was made, through a battery and induction coil, by the spring of the key and a platinum contact screw bearing upon its upper surface. When the key was depressed the primary current was broken, and then, after a short interval, the spring made contact with a lower platinum contact, thereby completing the secondary circuit, in which was a reflecting galvanometer. If there were no conducting core within the helix of the primary there would be no effect in the secondary, since all the inducing cause would be over before the secondary was completed. But if a metal core is placed within the helix, currents will be induced in it by the suppression of the primary, and these may still exist when the secondary is completed. These currents then, becoming insignificant in a time very short in comparison with the time of vibration of the galvanometer needle, will produce an induced current in the secondary which can be measured by the first swing of the galvanometer needle. The quantity thus measured is the induction existing in the secondary at the moment of its completion. It was found possible to measure this time of depression of the key with considerable accuracy. A condenser with a leak of 1000 ohms was so arranged that when the key was up it was charged from a battery; when the key was being depressed the charge leaked off through the resistance, and when the lower contact was made the remaining charge divided between the leak and a ballistic galvanometer, from the throw of which the time occupied by the depression could be calculated. In this way times varying from 1-1000th to 1-50th of a second could be measured. Several precautions are necessary, but a preliminary series of experiments showed that considerable accuracy could be attained. Various conductors were examined, and the curves thus obtained showed no deviation from the simple expression—

$$y = \mathrm{A}e^{-bx}$$

where x is the time and y the induction in the secondary coil.

Samuel Rideal, *Hon. Sec.*

NOTICES OF BOOKS.

Acetic Acid and Vinegar, Ammonia, and Alum. London: J. and A. Churchill.

This volume, which is one of the series of "Churchill's Technological Handbooks" does not bear the name of any author, but is edited by Mr. J. Gardner, F.C.S., who in the preface thanks Messrs James Taylor and John Linford for their co-operation.

In speaking of acetic acid the author first gives a sketch of its history and a notice of the sources whence it is obtained. The processes for its preparation are next explained. Here, as elsewhere, we notice the frequent reference made to Baumé's hydrometer. This instrument is not merely less commonly used in Britain than that of Twaddell, but it has the grave disadvantage of existing in three discordant varieties, so that the purchaser, without actual trial with some liquid of known specific gravity, never knows with which scale he has to do. Moreover the indications of Baumé cannot, as can those of Twaddell, be converted into direct specific gravity by a simple calculation.

Among the processes for obtaining crude acetic acid by the destructive distillation of wood, we find mention of the very interesting attempts made for the utilisation in this manner of sawdust, spent tanner's bark, and the residues of dye-woods. None of these methods has proved as successful as might have been hoped. The charcoal obtained is not liked by consumers, and there is some difficulty in freeing the acid from an excess of tarry and resinous substances. Sawdust, indeed, has ceased to be regarded as a waste product, and spent dye-woods are often more or less contaminated with a variety of other dye-wares and chemicals which complicate their treatment. Particular notice is due to Fry's process for obtaining acetic acid, methylic spirit, &c., from wood before it is used for paper-making. It seems to us that an important success may yet be reached in this direction. The tables quoted from Stoltze, showing the weights of acid and charcoal obtained from various woods, contain some items more curious than practically useful. Bird-cherry, savine, buckthorn, laburnum, and walnut (!) are not readily procurable in quantities and at prices suitable for industrial purposes.

The most important acetates are next described. The authors admit that wine-vinegar is of a more pleasant flavour than malt-vinegar, but they do not—as they might with perfect truth—extend this assertion to the apple-vinegars of America and the sugar-vinegars made and used in many households in England. Mention of this last kind leads us to remind the authors and the reader that, years before the researches of Pasteur had been heard of, the acetification of solutions of treacle or coarse cane-sugar was commonly effected by means of a fungus, known in Yorkshire as the "vinegar-plant."

Under ammonia we find a very full account of its production from gas-liquor, the ordinary source.

The synthetic processes of Margueritte and others are briefly noticed as unsuccessful, which, from a commercial point of view, is unfortunately true.

The processes for recovering ammonia and other volatile products, given off from coke-ovens and blast-furnaces, might, we think, have received a more complete notice, especially as it is here stated that they are attracting much attention among chemists and manufacturers. Ammonium molybdate is described as "the salt principally used in dyeing," a sentence open to misconstruction.

Under alum we have an account of the manufacture of alum from aluminous schists, from the treatment of clay, felspar, cryolite, blast-furnace slag, Redonda phosphates, &c., by treatment with sulphuric acid are mentioned.

We do not find any notice of the recent proposal for employing the waste of slate quarries as the raw material. It is sometimes forgotten by inventors that—save when it is furnished by nature—the sulphuric acid is the ingredient upon which the cost depends.

Among the compounds of aluminium of technical importance we miss mention of the sulphocyanide, now employed as a mordant for alizarin-reds, of the aluminate of soda, and of the practical methods of preparing hydrated aluminium chloride.

Under aluminium the improvements now being carried into operation by the Crown Metal Company (Webster's Patent) are alluded to. By this process the metal is obtained, if not at a reduced cost, still in a state of higher purity than has hitherto been found practicable on the large scale.

The bibliography of the subjects placed opposite the table of contents might have been advantageously extended. Thus mention might have been made of Dr. Lunge's treatise on the "Distillation of Coal-Tar and Ammoniacal Liquor," and of Dr. Borsch on the "Manufacture of Vinegar."

Whilst it has been our duty to point out certain oversights in the hope of their rectification in a future edition, we must not be understood as forming a condemnatory judgment upon the book as a whole. On the contrary, though, as we have shown, not incapable of amendment, we think it will form a valuable guide for the technological student.

CORRESPONDENCE.

REPAIRING PLATINUM VESSELS.

To the Editor of the Chemical News.

Sir,—In the Chemical News, vol. li., p. 181, Mr. J. W. Pratt mentions as new a method of "Soldering and Repairing Platinum Vessels" by means of gold chloride; in this Laboratory, however, the method has been used with great success for the last ten years.—I am, &c.,

G. T. H.

Chemical Laboratory, Normal School of Science.
South Kensington, May 8, 1885.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

Note.—All degrees of temperature are Centigrade unless otherwise expressed.

Justus Liebig's Annalen der Chemie, Vol. 208, Part 1.

The Action of the Copper Chlorides upon Metallic Sulphides.—F. Raschig.—Cupric chloride has a powerful chlorinising or oxidising action upon copper sulphide, whether in an acid, a neutral, or an alkaline solution. In the two former cases the metal is attacked, and the sulphur little or not at all; in an alkaline liquid the sulphur is almost entirely converted into sulphuric acid, and there is formed a mixture of oxysulphides. Cuprous chloride has little action upon the sulphide. Lead sulphide with cupric chloride forms copper sulphide and lead chloride. With zinc sulphide the products of the decomposition are analogous, as also with cadmium, iron, and cobalt sulphides. With mercury sulphide the result is a mixture which cannot be reduced to a simple formula, even after removal of the free sulphur.

On β Pyridin-tricarbonic Acid.—R. Voigt.—This acid forms spheroidal cyrystalline groups consisting of white crystalline needles. It is readily soluble in hot water, less readily in alcohol, with difficulty in cold water, and scarcely at all in ether. Its point of fusion is 227°. The free acid gives no precipitate with salts of calcium, strontium, magnesium, zinc, nickel, cobalt, copper, and mercury (mercuric); with barium chloride there is formed a white flocculent precipitate which disappears on boiling; mercurous nitrate gives a dense white precipitate, silver nitrate a gelatinous salt, lead nitrate a white deposit which re-dissolves on heating, cadmium sulphate a white apparently crystalline precipitate, manganous chloride a fine crystalline salt, ferric chloride a yellow precipitate, and ferrous salts a deep violet solution which shortly deposits a dark, almost black, salt of iron.

On Phosphor-sellinic Acid.—Hugo Schiff.—This acid is formed by the reaction of orsellinic acid and phosphorus oxychloride. Its composition is $C_{40}H_{36}P_4O_{24}$. It dissolves readily in the solutions of the caustic alkalies, in lime, and baryta-water, forming soluble salts of a violet-red colour. The salts of the heavy metals are violet-blue flocculent precipitates, insoluble in water.

The Combinations of Potassium Iodide and Bromide with Arsenious Acid.—H. Schiff and R. Sestini.—The author has examined two potassium iodide compounds, distinct from each other, and from Emmet's salt, *i. e.*, $3As_2O_3,2KI,6KOH$ and $3As_2O_3,2KI,2KOH$.

On β-Hydroxy-butyric Acid from Diabetic Urine.—A. Deichmüller, F. Szymanski, and B. Tollens.—Not adapted for useful abstraction.

Remarks on the Researches of R. Schiff on the Capillarity-Constants of Liquids at their Boiling-points.—P. Volkmann.—The author points out several defects in Schiff's manner of observation and calculation, admitting at the same time his merit in calling attention to the regularity in the capillary consonants at the boiling-point.

A New Absorbent for Oxygen.—Otto, Baron v. d. Pfordten.—The author makes use of a solution of chromous chloride, which he prepares as follows:—He first heats chromic acid with concentrated hydrochloric acid, so as to obtain a strong green solution of chromic chloride free from chlorine. This is then reduced with zinc and hydrochloric acid. The blue chromous chloride solution thus obtained is poured into a saturated solution of sodium acetate in an atmosphere of carbonic acid. A red precipitate of chromous acetate is formed, which is washed by decantation in water containing carbonic acid. This salt is relatively stable, and can be preserved for an indefinite time in a moist condition in stoppered bottles filled with carbonic acid. In this process the following precautions are to be observed:—Spongy flocks always separate from the zinc used in the reduction, which float about in the acid liquid for a long time and give off minute gas bubbles. If poured into the solution of sodium acetate they would contaminate the precipitate, and when dissolved in hydrochloric acid would occasion a slight escape of hydrogen. The solution of chromous chloride must therefore be freed from the zinc by filtration in the absence of air. For this purpose the reduction is carried on in a flask fitted up like a washing-bottle. The long tube is bent down outside the flask and is here provided with a small bulb-tube containing glass-wool or asbestos. The hydrogen gas liberated during reduction is at first let escape through this tube; afterwards its outer end is closed and it is pressed down into the liquid. The hydrogen must now pass through the shorter tube (the mouth-piece of the washing-bottle), whice has an india-rubber valve. When the reduction is complete the blue liquid is driven up in the long tube by introducing carbonic acid through the short tube, so that it filters through the asbestos into the solution of sodium acetate into which the reopened end of the long tube dips. When washing out the red precipitate, at first a little acetic acid is added to dissolve any basic zinc carbonate which has been deposited. In this manner a chromous acetate is obtained perfectly free from zinc. For the absorption of oxygen the compound just described is decomposed with hydrochloric acid in the following simple washing apparatus. Upon a shelf there are fixed side by side two ordinary preparation glasses, closed with caoutchouc stoppers, each having three perforations. Each two apertures receive the glass tubes used in gas-washing bottles, while the third holds a dropping funnel. It is filled with dilute hydrochloric acid, and after the expulsion of the air by a current of gas plentiful quantities of chromous acetate are passed into the bottles. When the current of gas has been passed in for some time the hydrochloric acid is let enter,which dissolves the chromous acetate, and thus, in the absence of air, produces a solution of blue chromous chloride. It is advisable to use an excess of chromous acetate, or an insufficient quantity of hydrochloric acid, so that there may be no free hydrochloric acid in the liquid. To keep back any free acetic acid which might be swept over by the current of gas, there is introduced after the wasting-apparatus another washing bottle with sodium carbonate. Also solid potassium carbonate may be used instead of calcium chloride for drying the gas. If the two apertures of the washing-apparatus are fitted with small pinch-cocks it is ready for use and merely requires to be connected with the gas apparatus in action in order to free the gas generated from oxygen. As but little chromous salt is decomposed by the oxygen such a washing apparatus may serve for many experiments.

On Diphthalyl.—C. Graebe and H. Schmalzigaug.—Not adapted for useful abstraction.

MISCELLANEOUS.

The Late Mr. Peter Squire.—Friends of the late Peter Squire will be interested to know that the unveiling of a medallion portrait of him will take place at the Pharmaceutical Society's House, 17, Bloomsbury Square, W.C., on Wednesday, May 20, at 4 p.m., by Sir Spencer Wells, Bart. Cards of admission may be obtained from the Secretary, 17, Bloomsbury Square. Any medical practitioner will be admitted, with a lady, on presentation of his address card.

MEETINGS FOR THE WEEK

Monday, 18th.—Society of Arts, 8. (Cantor Lectures). "The Manufacture of Toilet Soaps," Dr. C. R. Wright, F.R.S.
Tuesday, 19th.—Institution of Civil Engineers, 8.
— Royal Institution, 3. "Digestion and Nutrition," by Prof. Gamgee.
— Pathological, 8.30.
— Society of Arts, 8. "New Britain and the Adjacent Islands," by Wilfred Powell.
Wednesday, 20th.—Society of Arts, 8. "The American Oil and Gas Fields," by Prof. Dewar, F.R.S.
— Pharmaceutical, 11. (Anniversary).
Thursday, 21st.—Royal Institution, 3. "Poisons," by Prof. C. Meymott Tidy.
— Chemical, 8. "Calorimetric Method for Determining Small Quantities of Iron," by Andrew Thomson, M.A., B.Sc. "On Some Compounds of Calciums and Sulphur," by V. S. Veley.
— Royal, 4.30.
— Royal Society Club, 6.30.
Friday, 22nd.—Royal Institution. 8. "Garrick," by Mr. W. H. Pollock, at 9.
— Quekett Club, 8.
Saturday, 23rd.—Physical, 3. "Experiments showing the Variations caused by Magnetisation in the Length of Iron, Steel, and Nickel Rods, and on the Spectral Image Produced by a Slowly Rotating Vacuum Tube," by Shelford Bidwell. "Note an Electrical Symbols," by J. Munro. "On Electrolytic Decomposition," by J. W. Clark.
— Royal Institution, 3. "Organic Septics and Antiseptics," Prof. Odling.

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W. F. COTTON, Secretary and Manager.
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JOHN R. COOPER, Town Clerk.
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THE CHEMICAL NEWS.

Vol. LI. No. 1330.

CHEMICO-BIOLOGICAL EXAMINATION OF THE ORGANS OF BOJANUS IN ANODONTA.

By Dr. A. B. GRIFFITHS, F.C.S. (London and Paris), and HAROLD FOLLOWS, F.C.S., &c.

Being convinced that a thorough examination, both from a chemical and biological point of view, of the various problematical organs of the invertebrata will throw much light on their physiology and their relationship to the vertebrata, we intend investigating as thoroughly as possible many of these organs.

One of us has already presented to the Royal Society a memoir on the green-gland of the astacus, proving that the organ is physiologically the kidney of the animal. (See *Proceedings of the Royal Society*, No. 236; Chemical News, vol. 51, p. 121.) Following in the steps of the work detailed in that paper, we are desirous of bringing another chemico-physiological paper before the readers of the Chemical News.

We have been examining the organs of bojanus of the fresh-water mussel; and taking into consideration its morphological position in relation to other organs of anodonta, it suggests that it is of a secreting nature. These organs consist of two parts—an external portion which is a transparent sac-like body, containing a glandular internal mass which is of a brown colour.[*] The secretion of this organ is acid to litmus-paper, and on treating the secretions obtained from a large number of organs of bojanus with a hot dilute solution of caustic soda, and then adding hydrochloric acid, a precipitate is obtained which, when examined under the microscope, revealed them to be rhombic crystals of *uric acid*. We have proved them to be uric acid by first converting them into alloxanthine with nitric acid, and afterwards into purple murexide by the addition of ammonia. On treating the secretion of the organs with alcohol, these rhombic crystals are deposited, and are found under the microscope to be superficially coated with a thin layer of some brown colouring matter; this may probably be some urinary pigment or the animal chlorophyll which Dr. C. A. MacMunn has found pretty generally in the invertebrata. On evapourating the alcohol extract of the secretion (after the deposition of uric acid crystals) nearly to dryness, and dissolving in water, adding oxalic acid, and then allowing the solution to stand for some time, long prismatic crystals of *oxalate of urea* were deposited on a slide under the microscope.

Beyond the fact that the secretion contains *uric acid* and *urea*, there is a salt of calcium present in minute quantities. What the acid is in combination with the calcium we have not been able to ascertain, but intend to turn our attention to it at some future date. Further, we have also examined chemically and microscopically the blood contained in the vena cava before it enters the organ of bojanus, and found urea and uric acid as a constituent of that fluid. After leaving the vena cava, the blood passes into the organ of bojanus and thence to the branchiæ. The blood in the branchiæ contains *neither* uric acid or urea.

From this investigation two important conclusions are to be drawn:—

I. That the organ of bojanus is physiologically the kidney of the animal, getting rid of the nitrogenous waste matters (in the form of uric acid and urea) contained in the impure blood as it is brought to these organs by the vena cava.

II. That after the blood (which is colourless in anodonta containing white amœbiform corpuscles something similar to those found in human blood) has passed through the organ of bojanus, it is freed from urea and uric acid.

These facts establish the renal function of the organs of bojanus in anodonta.

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[*] For the anatomical structure of these organs, see a series of papers in the *Annales des Sciences Naturelles*, 1854 to 1861, by Lacaze-Duthiers.

REPORT OF THE PURIFICATION OF DRINKING-WATER BY ALUM.[*]

By Profs. PETER T. AUSTEN, Ph.D., F.C.S., and FRANCIS A. WILBER, M.S.

The many discoveries that have been made during the last years in regard to the transmission of diseases by drinking-waters have caused attention to be directed to the methods of its examination and the processes for purifying it. Chemical analysis can establish the presence of albumenoid matter in water, and by its means we are able to state if the water under examination can become a suitable nidus, or medium, for the development of disease germs. If the germs are actually there, or if the water contains a virus, or ptomaine,[†] biological examination alone can determine.

While physicians and scientific men are experimenting on the methods of water examination, and are endeavouring to understand fully the meaning of the results obtained, the public are chiefly interested to have some method by which they can purify their drinking-water in a simple, cheap, efficacious, and expeditious manner.

Running over the substances which have been suggested and tried for the purification of water, there is none that seems to offer the advantages of alum. Particular attention was directed to its use by Jeunet in 1865, in an article published in the *Moniteur Scientifique* (page 1007). He found that 0·4 gramme of alum to a litre of water (23·3 grains to one gallon) rendered it drinkable, even when it was quite full of foreign matter. The time taken for this clarification was from seven to seventeen minutes.

Alum is a double sulphate of potash and aluminium, and in this case breaks into potassium sulphate, which remains in solution, and a basic aluminic sulphate. This basic sulphate of aluminium, the composition of which is undetermined, precipitates as a more or less gelatinous and flocculent mass, and carries down with it the foreign matters and humus bodies. The sulphuric acid set free in the formation of the basic aluminic sulphate attacks the earthy and alkaline carbonates, which are always present, and forms with them sulphates, setting carbonic acid free. Aluminic sulphate acts like alum. Aluminic acetate and ferric acetate do not give such good results. Peligot, however, found that ferric chloride (sesquichloride of iron) acted well, and Scherer recommends the use of a neutral sulphate of iron.

In the last years an extensive use of alum has been made in the many processes of purifying water, sewage, &c. It is not improbable that, aside from its effect in precipitating matter mechanically by envelopment with the precipitating basic aluminic sulphate, the alum exerts a distinct coagulative action on the albuminous substances in the water, rendering them insoluble, and thus causing their precipitation; perhaps the same or similar effect that alum produces in the tawing of leather. One of the most prominent applications of alum at present is in the Hyatt

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[*] From the advance sheets of the "Annual Report of the State Geologist of New Jersey" for 1884.

[†] Putrefaction alkaloid.

filter. By the addition of a minute amount of alum, water is rendered capable of a most perfect mechanical filtration.

The fact that alum is cheap, and can be obtained in quite a pure state at any drug store, places it within the reach of every one. Its sharp taste precludes the possibility of its being swallowed by mistake. But even should it be swallowed by mistake, no great harm would be likely to ensue, unless a large amount were taken. In medical treatment as high as 30 grains are given in a single dose, and this may be repeated four times per day. If it can be proved that alum not only clarifies a water, but also removes from it disease germs and ptomaines, its use will prove of incalculable value to the human race, for facts begin to indicate that a vast number of diseases are communicated through drinking-water.

The investigation of the effects of alum on drinking-water falls under the several heads—

I. Clarification of the water by settling.
II. Clarification of the water by filtration.
III. Use of water clarified by alum in manufacturing.
IV. Removal of disease germs.
V. Removal of ptomaines.
VI. Removal of organic matter.

The investigation must needs be both chemical and biological. Only the first and part of the second cases have so far been examined.

I. *The Effect of Alum in Clarifying Water by Settling.*

It is evident that to obtain practical results in the clarification of water by alum, it must be added in such small amounts as to leave no unnecessary excess, and that neither taste nor physiological action should be imparted to the water. At the time of our experiments (January, 1885), the New Brunswick city water was quite turbid from clayey and other matters, so that we were able to obtain some very reliable results.

The amount of alum used in the experiments of Jeunet seems to be unnecessarily high, in case the water is to be drunk. Water was treated with the amount of alum recommended by Jeunet (23·3 grains to the gallon), but no perfect settling was obtained under six hours or more; in some cases not under twelve hours. The water thus treated had no perceptible taste of alum, but it gave a decided reaction for alumina when treated with ammonia, showing that the water contained a certain amount of free alum. While the amount is evidently too small to produce any physiological effect, there seems to be no necessity to use such an excess.

To determine the effect of alum as a precipitating agent, tall cylinders were filled with water and a solution of alum was added, the whole well mixed, and allowed to stand. It was found that in varying lengths of time, depending on the amount of alum used, a gelatinous precipitate settled out, and the water above it became perfectly clear. On adding a relatively large amount of alum, and mixing, the coagulation and separation of the precipitate is at once visible, the water appearing by careful examination to be filled with gelatinous particles. The amount of alum necessary for the precipitation of a water will, of course, depend on the amounts of impurity present, but in the present case, which may be taken as a typical one, we found that 0·02 gramme of alum to a litre of water (1·2 grains to a gallon) caused the separation and settling of the impurities, so that the supernatant water could be poured off. This amount of alum was shown by numerous experiments to be about the practical limit. The complete settling took place as a rule in not less, and usually more, than two days. It is evident that the amount of alum thus added is too slight to be perceptible to the taste, and can exert no physiological action. We were unable to detect the slightest taste or change in the water so treated.

Still smaller amounts of alum will produce a precipitate after longer standing. Sixty litres of the city water were treated with 2 grammes of alum (this was about 31 grains to 16 gallons) and allowed to stand. After forty-eight hours the precipitation seemed complete, and the water was perfectly clear, while the bottom of the vessel was covered with a brownish, slimy deposit. This substance was collected, dried, and analysed. It gave—

Carbon..	16·50	per cent.
Hydrogen	2·02	,,
Nitrogen	0·77	,,

It is evident from this analysis that a large amount of the organic matter has been removed from the water by the alum treatment.

On incineration, it yielded 59·28 per cent of ash, which contained silica and alumina in relatively small amounts, oxide of iron in large amounts, and a considerable quantity of phosphoric acid.

To determine if there was free alum in the water, a sample of the clear water, filtered off from the precipitate produced by the alum, was made slightly alkaline with ammonia and warmed for some time. Only the merest traces of an alumina reaction could be obtained, and, in fact, in some cases, it was doubtful if a reaction was observable. To prove that no more matter could be precipitated by the addition of a greater amount of alum, samples of the clean filtered water were treated with more alum, but there was in no case any indication of further precipitation on standing.

We consider it, then, established that, by the addition of 2 grains of alum to the gallon, or half an ounce to one hundred gallons, water can be clarified by standing, and that neither taste nor physiological properties will be imparted to it by this treatment. By increasing the amount of alum the time required for the separation and settling can be diminished, and *vice versa*, by diminishing the amount of alum added, a greater time will be required for the clarification.

This method is particularly adapted to the clarification of large volumes of water where filtration is not practical. The cleared water can be racked off to as low a level as possible, after which the sediment should be washed out and the receptacle cleansed by a free use of water.

II. *The Effect of Alum in Clarifying Water by Filtration.*

In order to test the clarification of water by filtration after addition of alum, the New Brunswick city water was again made the subject of our experiments. It was found that the suspended clayey matters were so fine that the best varieties of filtering papers were unable to remove them. Even when several layers of heavy Schleicher and Schüll paper were used, a very large portion of the suspended matters passed through. This, however, is not surprising, since it is well known that the mineral matters suspended in water are of a remarkable degree of fineness. Thus the water of the river Rhine, near Bonn, cannot be clarified by simple filtration, and takes four months to settle. The addition of certain chemicals aids the filtration of suspended matters in some cases, but it does not always entirely remove them. Calcium chloride and other salts are recommended as effective agents in aiding the removal of suspended matters, but in the case of New Brunswick water, at least, they have no apparent action. The following substances were found to have no effect in aiding the filtration of the water: sodium salts—chloride, carbonate, nitrate, acid carbonate, hydrogen phosphate, acid sulphite, ammonium phosphate, sulphate, biborate, tungstate, acetate; potassium salts—hydroxide, chloride, bromide, iodide, acetate, phosphate; ammonium salts—chloride, sulphate, nitrate, acetate; calcium salts—oxide, chloride, sulphate, nitrate. Zinc sulphate and ferrous sulphate (copperas) had no action. Acid sulphate of potassium and of sodium had a slight clearing action. Acetate and chloride of zinc had an apparent action. Ferric chloride (perchloride of iron) cleared perfectly, as also did the nitrate and sulphate of aluminium.

By the addition of a small amount of alum to water it can be filtered through ordinary paper without difficulty, and yields a brilliantly clear filtrate, in which there is no trace of suspended matter. In our experiments a solution of alum was added to the water, the whole well mixed by stirring or shaking, and then filtered after standing from one to fifteen minutes. So far as we are able to determine, the coagulative and precipitative action of the alum is immediate upon thorough mixture, and hence it is not necessary to allow the mixture to stand before filtration, but it can be filtered immediately after mixing.

To determine the amount of alum necessary to precipitate this water, alum was added in decreasing amounts to samples of water, which were then filtered through Schleicher and Schüll paper. In this way we found that the minimum limit was about 0·02 grm. of alum to 1 litre (1·16 grains to one gallon). Beyond that point the action of the alum began to be doubtful, and the water, although clarified by filtration, was not wholly clear. To be sure of complete clarification, we took double this amount—0·04 grm. to one litre (2·3 grains to one gallon)—as a standard calculated to give certain results. This amount can be doubled or trebled without fear of any harmful results, but there is no use of adding any more alum than is sufficient to do the work. The determination of the amount of solids removed from the water by the clarification with alum had not yet been finished.

We consider it, then, as established that, by the addition of two grains of alum to the gallon of water, or half an ounce to the hundred gallons, water can be rendered capable of immediate clarification by filtration. The clear water obtained by filtration, after adding this amount of alum, contains no appreciable amount of free alum, and, in fact, in the majority of cases, ordinary tests fail to reveal its presence.

While the clarification of water by standing is very successful and well adapted to the treatment of large volumes of water, especially when time is not an element of importance, the case will very frequently occur that a relatively small amount of water is to be purified in a short time. In such a case not clarification alone is demanded, but it is necessary that the operation should take as short a time as possible. Again, in order to make this method of clarification practical for domestic use, the operation of filtration must be made extremely simple. No complicated or expensive apparatus should be used, but the filter must be made out of the simplest articles, such as can be found in every household. In this field there is an opportunity for the exercise of considerable mechanical ingenuity, and when the principles of the filtration are understood, and more is known about the different kinds of filtering materials, there will doubtless be many forms of house-filters devised out of the odds and ends which may be at hand.

It is not a difficult matter to get up a large filter that shall clarify many hundred gallons of water a day in an effective manner. Such apparatus already exists, and is used in manufacturing establishments. In their construction many points—such, for instance, as the cleansing of the filtering material—have been brought to a high grade of perfection. The difficulty lies in devising some form of simple and cheap filter which will filter a small amount of water as effectively as a relatively large amount, which will be always ready, will always work, will be so simple that anyone can understand its operation, can be easily made, not easily broken, but easily repaired if broken, and which will not entail much extra work in order to get a clarified water. The filtering material must be cheap, easily obtainable, easily prepared, capable of being cleansed when clogged by use, or so cheap that it can be thrown away and replaced by new without appreciable expense.

It is evident that the shape, size, and arrangement of the filtering apparatus will depend very largely on the kind of filtering material used. Hence we began by experimenting on filtering media. The glass funnel and carefully folded paper will be of but little service outside of the laboratory. But in cases of great importance, such as the preparation of water for the sick, this method is worthy of attention.

In the large Hyatt filters a mixture of coarsely ground coke and sand is used, and does most admirable and effective work. Granulated bone charcoal also makes a most excellent filtering-bed. The most practical material for domestic use, however, so far as we have been able to ascertain, is cotton. Cotton batting can be bought in the shops for about ten cents a pound, and a pound of it will go a long way in filtering. It makes a coherent filtering layer, and when clogged by use can be cleansed by boiling up in water and rinsing, or, as it is so cheap, can perhaps as well be thrown away and replaced by new.

The simplest form of filter for filtering considerable amounts of water is a tube one end of which is stuffed with cotton. A drain-pipe is the best material, since it can be so easily cleansed. The plug of cotton should be from 2 to 3 inches thick, and may be held in place by a round piece of wood fitting into the bottom of the drain-pipe at its shoulder, and secured by any suitable means. The piece of wood should be perforated, to allow the water to pass through. The shoulder of the pipe may be set in a circular channel cut in a piece of board, and by means of a central channel the water may be made to run off at at a point of delivery. In our next report we shall present plans of simple filters, and the results of our experiments with them.

The most practical form of filter for household use, and one that will easily filter a pitcherful of water in a short space of time, can be made out of a bottle. The best form is the long kind in which sweet oil is sold, although almost any kind of glass or earthenware bottle will answer. The bottom of the bottle is cracked off, and the sharp edge removed by rasping with a file. The cracking can be done by tying a thin, soft string, soaked in turpentine, around the place where it is intended to crack leaving as small a knot as possible, then setting fire to the turpentine, holding the bottle bottom up. After allowing the oil to burn for an instant the end of the bottle is placed quickly in cold water, when, if the operation has been rightly conducted, an even crack will be produced, and the bottom of the bottle will come off easily.

A layer of cotton is now placed in the bottle. The cotton must be worked in water, preferably warm water, in order to remove the adhering air, and to wet it well. A wad of the wet cotton is propped into the bottle, and covers the mouth of the neck. Other pieces are dropped in, care being taken to build the layer up evenly, and to add the cotton in rather small pieces. After dropping them in, they should be pressed down and arranged by means of a rod. In this way a layer is made which should be from 2 to 3 inches thick. It should not be pressed down too tightly, else it may filter too slowly; neither should it be too light, or water may form channels through it. After a little use the plug generally adapts itself. Particular care should be taken to be sure that the cotton is snug against both sides, since the water is liable to escape there. The plugs, however, are easy to make, and a few attempts will soon teach one all the necessary manipulations.

This bottle filter can be suspended or supported in any convenient way. Perhaps the simplest support is a block of wood having an auger hole bored through the centre, and the edges of the hole reamed out. In this hole the bottle sits securely, and the bevel of the hole catches the shoulder of the bottle, thus holding it upright. To use this filter it is only necessary to pour the water, which has been previously mixed with the right amount of alum, into it, when the clear water will run in a considerable stream from the bottom, and can be caught in any convenient receptacle. It is well to throw away the first tumblerful that runs through, if the plug is a new one, as a little sediment will pass through at first, but this soon stops. It is also advisable to keep the bottle nearly full while filtering, as this hastens filtration.

The mixing of the water with the alum previous to the filtration should be done in a separate receptacle. The only requisite here is that the vessel in which the mixing is done must be clean. A pail, jug, can, or any other vessel used in the kitchen will do. It is well to have the pail or can marked on the inside with scratches, so as to be able without difficulty to judge how much water there is in it, since the amount of alum should be added in about the right proportions. The eye gets very accurate in judging the volume after a little practice, but it is better and just as easy to be accurate. A clean tin can of two to four gallons capacity is a good size, and, if possible, should not be used for any other purpose than for the drinking water. It should be kept scrupulously clean, and after each use should be washed out and dried. It can be graduated by pouring into it a gallon of water, and marking with a file or other sharp point a scratch just at the level of the water. Then another gallon is poured in, and its level also marked. In this way a graduation is easily made which is sufficiently accurate for all the purposes here intended. As a rule, a can of 4 gallons capacity will be found quite large enough to filter the water used by a family of average size. The necessary amount of the alum solution is added to the water, the whole well mixed by stirring, and then poured into the filter. Here, again, one or two points should be observed. The mixing is best done with a long-handled spoon. A very practical stirrer is a small cake turner, for by means of its flat end a most thorough mixing can be effected. This mixer should not be used for any other purpose than to mix the water. Experience shows that, if the vessels used for mixing or holding the water are not kept perfectly clean the water may acquire a taste, and this will be laid to the process instead of to lack of care. To facilitate the pouring into the filter, it is well to have the can provided with a mouth or spout. In fact, there is no form of can better than the regular garden watering-pot, with its long spout.

The solution of alum is made as follows:—Dissolve half an ounce of alum in a cup of boiling water, and when it is all dissolved, pour into a quart measure, and fill to a quart with cold water. (This solution should be kept in a bottle labelled "Alum.") Fifty-four drops of this solution contain 2·3 grains of alum, which is the amount to be added to one gallon of water. The old-fashioned teaspoon holds about forty drops; the new spoons, however, hold about seventy drops. Hence, a modern teaspoon, scant full, will be about the right amount to add to every gallon of water to be filtered. No harm would be done if by mistake two teaspoonfuls are added; in fact, ten teaspoonfuls would have to be added to bring the amount of alum up to the figure recommended by Jeunet (*loc. cit.*) A more satisfactory method will be to procure a small measuring glass. One fluid drachm will be the right amount. It will be found, without doubt, that the amount required for some waters will be even less than that suggested above. We would suggest, therefore, that those who use this method of clarification determine for themselves by experiment how little of the solution is required to make the water they use run through the filter perfectly bright and clear.

Chemical Laboratory of Rutgers College.

Ammoniacal Copper Sulphate and on a Basic Copper Sulphate.—G. André.—On passing for a long time a current of ammoniacal gas into a saturated and refrigerated solution of copper sulphate all the copper is precipitated, the bottom of the vessel being covered with fine crystalline needles, to which the author gives the formula $SO_4Cu,2NH_3,HO$. This compound, if heated in a sealed tube to 200° for five hours along with 10 parts of water, is decomposed and deposits black copper oxide on the sides of the tube. If it is heated gently along with water and metallic copper in a flask which communicates with the atmosphere only by a narrow tube, the basic sulphate is produced.—*Comptes Rendus.*

APPARATUS FOR THE DETERMINATION OF NITROGEN BY THE COPPER OXIDE METHOD, AND COMPARISON OF THIS AND THE RUFFLE METHOD.

By CHARLES W. DABNEY, Jun., and B. VON HERFF.

The determination of total nitrogen has become the most important operation which the agricultural chemist has to perform. Such high values are attached to the nitrogenous materials in superphosphates that small variations in the determination of nitrogen will make considerable differences in the valuations. It becomes necessary, thus, for the agricultural analyst to attain the greatest possible accuracy in his rapid routine work. Since the introduction of a great variety of different compounds of nitrogen into fertilisers, this problem has become quite a difficult one, and has caused us to try every new method and every improvement which has been suggested.

The two methods which we shall discuss here have each their merits, and both come reasonably near meeting all these requirements. These are the Ruffle method and the copper oxide, or so called "absolute" method.

1. *The Ruffle Method.*—We have worked this very nearly as described by its author,* using Bohemian glass combustion tubing always, however. We have not tried the method without soda, or without hyposulphite, has as been suggested.

This method has the advantage of being simpler, cheaper, and somewhat quicker than the copper oxide method. There are fewer risks to run, fewer combustion tubes break, and for several reasons a much larger per cent of complete analyses are obtained by it.

The tube we have used was exactly like the ordinary soda-lime combustion tube. Charcoal, free from nitrogen, was obtained, and the mixture with sulphur was weighed out in 2 grm. portions. The soda-lime and fused hyposulphite were mixed by eye. In making the combustion a noteworthy precaution is to heat the tube very slowly at first, especially in case of compounds containing high per cents ofnitrogen. In some cases the determination may require three hours. If the combustion is too much hastened the results will be too low. Ordinarily we have found that an hour and a half is necessary for making two such determinations together, the weighing and filling the tubes included. Occasionally we have found the final reaction in titrating rather indistinct when this combustion had been made.

2. *The Copper Oxide Method.*—We have followed the method as described by Prof. Johnson† in the main. We have not found it necessary to pass oxygen, however, in most cases, and have, therefore, omitted the chlorate of potash from the end of the tube. In mixtures containing a good deal of horn, where resistant cyanogen compounds are formed, this oxygen may be of some aid in completing the combustion.

In analysing compounds rich in nitrogen, and especially those containing much nitrate, the addition of charcoal powder to the substance causes the nitrogen to come off more regularly, and give generally better results.

For making two analyses together by this method we have found that about two hours are required. This depends, however, chiefly upon how the pump works. In making this estimate of the time required we refer to the pump described below, which never took more than ten minutes to complete the exhaustion.

For getting the air, before combustion, and the nitrogen afterwards, out of the tube, we have used carbon dioxide without a pump and have obtained excellent results, though more time is consumed in this way than with a good pump. Magnesite or carbonate of manganese, put

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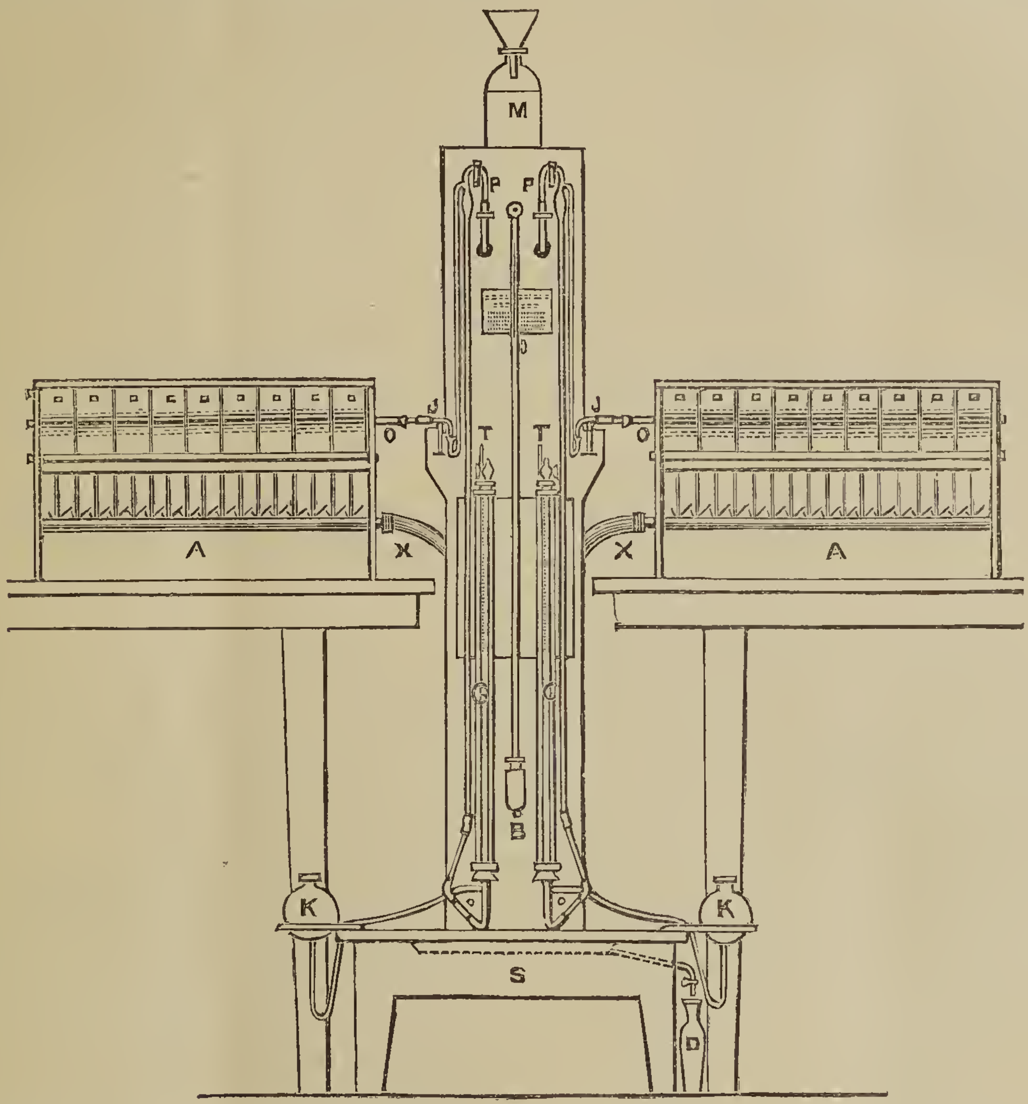
* *Journ. Chem. Soc.*, xxxix., 87.

† *American Chemical Journal*, ii., 27.

in the back end of the tube, are the best sources of carbon dioxide for this purpose. They give off their carbon dioxide slowly and uniformly. Bicarbonate of soda can be used also, though it is liable to give off its gas too suddenly.

In our experience this method of driving the nitrogen out is far preferable to working with a poor, or slow, pump. We recommend it to those who do not want to invest in a Sprengel pump. If you can get a fast-working, tight pump, a combination of both plans of getting the nitrogen out is the best and quickest method.

It was with some difficulty and after numerous trials of pumps of different forms that we got one which met all the requirements. This pump and the connected apparatus for making two nitrogen determinations at the same time is shown in the figure.



The only glass part which is necessary to have made by an expert glass-worker is the piece from P to rubber joint above O and its branch to J, with the ground-glass joint there. The little jet tube in the bulb is wanting in the cut. The length of tube from the bulb to O should be 1·2 m. The length of the branch to J will be regulated to suit the height of your table. The ground joint at J is a great convenience. If a perfect one cannot be obtained, it can be dispensed with and you can get the necessary play in the rubber joint, also indicated at J, which otherwise is omitted. A rubber band over a nail holds the connecting tube firmly into the ground joint.

The speed of the pump will depend much upon the calibre of the jet tube and its relation to that of the fall tube. In our best pump the relation is, internal diameter of the jet tube at smallest place 1·5 m.m., internal diameter of fall tube 2·5 m.m. The branch tube to J should have an internal diameter of about 2 m.m.

The stand to which all of the apparatus is fastened has for its base a shallow box 70 × 70 × 10 c.m. on legs, making it 35 c.m. high. This is the mercury receiver, and it has an outlet with a pinch-cock at a place convenient for drawing the mercury in the flask, D, for returning it to the reservoir, M. The front half of the top of this box raises up as a lid. Two holes in the back half of it carry the funnels which catch the mercury. The upright frame is 1·3 m. high above top of base and is well braced behind. It is 25 c.m. wide and has two holes at a convenient place for the stout rubber tubes which convey the mercury from the reservoir, M, to the pumps, P P. The flow of mercury is controlled by a pinch-cock just below P. The mercury reservoir, M, is an extra strong 1 gal. aspirator bottle. The tubulature is behind for convenience.

The azotometer with its thermometer, T, and graduate, G, connected with the potash solution reservoir, K, which can be raised or lowered as desired, is that of Schiff, figured and described by Prof. Johnson in the *American Chemical Journal*.* The water connections with the jacket of the azotometer are not figured, because they would complicate the cut, and because it is not necessary to pass water around the nitrogen graduate if one can wait an hour for all the parts to take a uniform temperature before taking the readings.

The barometer is hung conveniently between the pumps. The other details, the connection with the combustion tube, C, in the furnace, A, and the gas, X, need no explanation.

The glass parts, described above, were made by our specifications by Mr. Emil Greiner, manufacturer of scientific glass apparatus, 345 E. 18th street, New York city.

A pump of this kind meets all the requirements of the

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* *Loc. cit.*

No.	Material.	Ruffle Method.			Copper Oxide Method.			Diff. between Ruffle and Copper Oxide.	Nitrogen calculated.	Error by Ruffle Method.	Error by Copper Oxide Method
		Nitrogen per cent.	Diff.	Average.	Nitrogen per cent.	Diff.	Average.				
1.	Para-nitro-benzanilid	11·45 11·54	0·09	11·495	11·70 11·64	0·06	11·670	−0·175	11·570	−0·075	+0·100.
2.	Nitrate of potash	13·75 13·72	0·03	13·735	13·65 13·75	0·10	13·70	+0·035	13·861	−0·126	−0·161
3.	Nitrosalicylic acid..	7·50 7·40	0·10	7·450	7·69 7·62	0·07	7·655	−0·205	7·690	−0·24	−0·04
4.	Dinitro-phthalyl-toluidid ..	12·59 12·65	0·06	12·620	12·85 12·97	0·12	12·910	−0·29	12·844	−0·224	+0·066
5.	Ammoniated cotton fertiliser	2·10 2·07	0·03	2·085	2·06 2·07	0·01	2·065	+0·020			
6.	Fertiliser, with tobacco refuse	2·10 2·15	0·05	2·125	2·21 2·18	0·03	2·195	−0·07			
7.	Ammoniated superphosphate with 1 p. c. N from nitrate	2·10 2·12	0·02	2·110	2·11 2·04	0·07	2·075	+0·035			
8.	Ammoniated superphosphate with animal and vegetable matter and nitrate	2·10 2·06.	0·04	2·080	2·08 2·11	0·03	2·095	−0·015			
9.	Shoemaker's bone meal ..	6·74 6·69	0·05	6·715	6·73 6·82	0·09	6·775	−0·060			
10.	N. C. fish-scrap	7·52 7·49	0·03	7·515	7·64 7·71	0·06	7·675	−0.160			
11.	Cotton-seed meal extracted..	7·79 7·94	0·15	7·865	8·06 8·09	0·03	8·075	−0·210			
12.	Chincha Island Peruvian ..	7·21 7·30	0·09	7·255	7·27 7·27	0·00	7·270	−0·015			
13.	Shoemaker's "Ammonite B"	12·65 12·72	0·07	12·685	12·73 12·71	0·02	12·725	−0·035			
14.	Dried blood	14·60 14·57	0·03	14·585	14·85 14·69	0·16	14·770	−0·185			

case. It exhausts the combustion tube rapidly and is easy to manage. It is best to turn on the full head of mercury for the first two minutes and then gradually diminish the pressure by partially cutting off the stream. By evolving some carbon dioxide in the combustion tube after five minutes pumping, the last trace of air can be swept out of the tube in eight to ten minutes. The following results will illustrate the working of two pumps we have at the N. C. Experiment Station. Two ordinary combustion tubes of equal length were filled as for analysis and connected at ordinary temperature with the pumps, and the amounts of air removed from each in successive minutes were measured under equal temperature and pressure.

Minutes.	Pump No. 1. C.c. of Air Removed.	Pump No. 2. C.c. of Air Removed.
1	65·0	62·0
2	16·0	12·0
3	5·2	3·8
4	0·2	2·9
	86·4	
5		1·8
6		1·7
7		0·6
8		0·2
		85·0

As the careful worker will generally want to make two distinct determinations in each material, this arrangement of two complete and symmetrical sets of apparatus will be found to greatly promote comfort and save time.

Comparative results by the Ruffle and Copper Oxide Methods.

Using the apparatus and methods described above, we have made a great many comparisons of these two plans of determining nitrogen. The following list of materials is selected to represent a wide range of substances:—

1. Para-nitro-benzanilid—
$$C_6H_4,NO_2,NH,COC_6H_5=C_{13}H_{10}N_2O_3.$$
Well crystallised, pure.

2. Nitrate of potash, KNO_3, pure, crystallised.

3. Nitro-salicylic acid—
$$C_6H_3,OH,NO_2,COOH=C_7H_5NO_5.$$
Pure, well crystallised.

4. Dinitro-phtalyl-toluidid,—
$$C_6H_2,CH_3,(NO_2)_2,N(CO)_2C_6H_4=C_{15}H_9N_3O_6.$$

5. An ammoniated cotton fertiliser, animal ammoniate and a small amount of nitrate of soda.

6. A fertiliser containing tobacco stems and dust (in which we have found nitrates), fish-scrap, and small amounts of sulphate of ammonia and Peruvian guano.

7. An ammoniated superphosphate, said to contain 1 per cent of nitrogen from nitrate.

8. A superphosphate ammoniated with animal matter, vegetable matter, and it was said 0·5 per cent nitrogen from nitrate.

9. Shoemaker's bone meal, from bone extracted with naphtha.

10. Ordinary North Carolina fish-scrap.

11. Cotton seed meal extracted with naphtha, quite dry and free from oil; from Shoemaker, Philadelphia.

12. Peruvian guano, said to be Chincha Island.

13. Shoemaker's "Ammonite B," mostly extracted muscular tissues of various animals.

14. Dried red blood, from Shoemaker.

Two Ruffle determinations, made at the same time, are given for each substance. The two nitrogen per cents were made by the copper oxide method in duplicate, as described above. All of the determinations in each column were conducted as nearly as possible in the same way. No charcoal was used or oxygen passed in the copper oxide determinations. The results are not all as near together or as near the calculated per cents as they should be, but they serve to show what the methods will do when followed blindly and unvaryingly. When special precautions were used, as the mixture of charcoal directly with nitro-compounds, better results were obtained.

In the column of differences between averages of Ruffle results and averages of copper oxide results, Ruffle is + and copper oxide is −. Copper oxide gives results mostly a little higher than Ruffle.

These analyses and many others in our possession show that in fertilisers containing small amounts of nitrogen, the Ruffle method and the copper oxide method give equally good results. By the copper oxide method the errors are apt to be in the direction of too much, by the Ruffle method in the direction of too little.

In substances containing larger amounts of nitrogen the differences are greater. Such substances undoubtedly require special precautions. Highly nitrated compounds should have charcoal or sugar mixed with them, &c.

In general it may be said that the Ruffle method is as well suited to the general uses of the chemical laboratory as the copper oxide, or so-called "absolute" method. The latter method, with the aid of the apparatus described above, leaves, however, little to be desired, so that it may be said now that we have two almost equally available and convenient "absolute" methods which can be used to check each other.—*American Chemical Journal.*

A CATALOGUE OF CHEMICAL PERIODICALS.*

By H. CARRINGTON BOLTON, Ph.D.,
Professor of Chemistry in Trinity College, Hartford, Conn.

(Continued from p. 233).

Explanation of Signs.

\+ Following a date signifies current at the date in question.
|| Following a date signifies publication discontinued.

45. Berlinisches Jahrbuch der Pharmacie. 1 vol., 12mo. Berlin, 1795.

Continued under the title;

[a] Berlinisches Jahrbuch für die Pharmacie und für die damit verbundenen Wissenschaften. 42 vols. (II.-XLIII.), 12mo. Berlin, 1796-1840 ||

From 1803-'10 *published with the additional title:* Neues Berlinisches Jahrbuch für die Pharmacie, [*edited by* F. A. Gehlen *and* Val. Rose]. *From* 1811-'14, *with the additional title:* Neues Jahrbuch der Pharmacie, herausgegeben von W. Döbereiner. *From* 1815-'29, *with the additional title:* Deutsches Jahrbuch für die Pharmacie. *Edited from* 1818-'20 *by* C. W. G. Kastner; 1821-'25, G. H. Stoltze; 1826-'29, Wilhelm Meissner; 1830, '31, A. Lucas; 1833-'40, Lindes.

Berzelius, J.
See Afhandlingar i Fysik, Kemi [&c.]; *also*, Årsberättelse om Framstegen i Physik och Chemi; *also*, Rapport annuel sur les progrès des sciences physiques et chimiques.

Berzelius' Jahresbericht.
See Jahresbericht über die Fortschritte der physischen Wissenschaften.

Biblioteca di Farmacia.
See Giornale di farmacia - - - Cattaneo.

46. Bibliothek der neuesten physisch-chemischen, metallurgischen, technologischen und pharmaceutischen Literatur. Herausgegeben von S. F. Hermbstädt. 4 vols., 8vo. Berlin, 1788-'95.

Continued under the title;

[a] Annalen der chemischen Literatur. Herausgegeben von Wolf. 1 vol., 8vo. Berlin, 1802.

Biedermann, R.
See Centralblatt für Agriculturchemie; *also*, Chemiker-Kalender; *also*, Technisch-chemisches Jahrbuch.

47. Boston Journal of Chemistry. Devoted to chemistry, as applied to medicine, agriculture, and the arts. [*From* vol. v., devoted to the science of home life, the arts, agriculture, and medicine.] Edited by Jos. R. Nichols. 14 vols., 4to. Boston, (July) 1866-'80.

Continued under the title:

[a] Boston Journal of Chemistry and Popular Science Review. Devoted to chemistry, pharmacy, geology, agriculture, astronomy, hygiene, medicine, practical arts, home science, [&c.]. 2 vols. (XV.. XVI.), 4to. Boston, 1881, '82.

Continued under the title:

[b] Popular Science News and Boston Journal of Chemistry. A journal of useful knowledge for all classes—house-keepers, farmers, mechanics, physicians, druggists, dentists, chemists, lawyers, &c. 2 vols., 4to. Boston, 1883, '84+

(To be continued).

NOTICES OF BOOKS.

The Structure of the Wool Fibre in its Relation to the Use of Wool for Technical Purposes. By F. H. Bowman, D.Sc., F.R.S.E., F.L.S., F.C.S., &c. Manchester: Palmer and Howe; London: Simpkin, Marshall, and Co.; Philadelphia: H. C. Baird and Co.

It is our pleasing duty to welcome here the companion-work to Dr. Bowman's "Structure of the Cotton Fibre," and to express the conviction that in comprehensiveness, thoroughness, and practical value the present treatise falls in no respect short of its predecessor. The author, as it may be easily gathered from his introductory chapter, is a technologist of the new, and we hope the increasing, school. At once a practical manufacturer and a man of science, he insists upon the necessity, in any and every art, of a thorough knowledge of the raw material upon which we have to work, and of a mastery of the principles and laws which underlie all the processes which such raw material undergoes during its conversion, mechanical or chemical, into the state of finished goods. He shows that by attention to these considerations we may make the best of any given materials, putting everything not only to use, but to its best use.

The mere routineer who is neglectful herein has often in consequence to use a more expensive material, when a cheaper one properly treated would answer the same purpose, and he thus places himself in a disadvantageous position in the markets of the world. He reminds his readers as of a well-known fact, of numerous cases where the lustre of wool has been destroyed by the chemical agents used to clear it, and where, in consequence, the finished product is no better than if a lower quality of wool had been used and turned to the best advantage.

But he goes much farther: he points out that the woollen manufacture—and the fact is capable of being generalised—consists of a number of distinct processes, each carried out by distinct hands, generally ignorant of or indifferent to the subsequent operations. Hence it naturally happens that "the means employed in some of the earlier stages of the manufacture are absolutely detrimental to those which are to follow afterwards and render it quite impossible to attain the results which were desired. You all know that the spinner and the weaver, who are usually quite distinct from the dyer and the finisher, very seldom either know or consider the processes

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* Advance-proofs from the *Annals of the New York Academy of Sciences.*

to which the yarn or goods will be subjected during the dyeing and finishing, and hence it frequently happens that the latter has to remove defects which might be avoided by more care and forethought in the earlier stages of manufacture." Hence it is not sufficient that each stage of the process should be conducted efficiently; it must be managed in such a manner as not to interfere with the remaining stages. Or, as the author puts it: "What we want is an intelligent understanding of every process and the co-ordination of each to the after treatment of the fibre, so that every step will be a step in the right direction, and each process, while perfectly fulfilling its special function, not in any way interfering with any operation which succeeds it."

To effect such a co-ordination, overlookers, managers, and above all the heads of manufacturing establishments, must be at once practical and scientific. No mere training of private workmen, or even foremen, will suffice. Even, *e.g.*, the most skilled dyer in the world must work at a disadvantage if the materials, when they reach him, have undergone treatment which unfits them to receive tinctorial substances.

It is obvious that the knowledge required is not such as can be summed up in receipts, or gathered from mere routine. We must have general principles, derived from practical experience, but made applicable to all possible cases. The "little master" of the last century who carried on every stage of the woollen manufacture in a couple of sheds behind his house, with the assistance of his own family and an apprentice or two, is out of date. But the mere capitalist-manufacturer of the earlier half of the present century, who thought himself master of his craft because he knew how to buy raw materials and to sell his finished goods, is perhaps even a more unfortunate anachronism. The "little master" was, at any rate, practically acquainted with every branch of the trade, and did, according to the lights of his day, keep all departments in harmony.

This introductory chapter alone is worth the price of the book, and deserves the most careful consideration. Passing to the body of his subject, Dr. Bowman contrasts the animal textile fibres, silk, wool, and hair, with the plant-fibre discussed in his former work. He explains the growth of hair, the difference between hair and wool, pointing out that both are simply modifications of one and the same epidermal excrescence. This part of the subject is illustrated with figures of wool and hairs, as seen under high magnifying powers. Upon this follows an account of the different breeds of sheep over the world, with notices of the peculiarities of their wool. The variations from the typical structure of wool are next considered as depending upon breed, upon climate, and upon season. Lastly we come to the great practical question, how far such variations affect the use of wool in the arts, both mechanically and chemically? With the former of these considerations we have no direct concern, but the chemical modifications of wool, with their influence on the dyeing process, must claim our attention for a brief space.

After insisting on the subjective character of our colour-impressions, Dr. Bowman describes some interesting spectroscopic observations on the surfaces of a large number of dyed fabrics. He finds that a number of colours which appear almost identical to the eye differ greatly in the colour of their reflected light. After mentioning the characteristics of perfect dyeing, *viz.*, clearness of colour and permanence, he proceeds to the discussion of the three theories of the dyeing process, and expresses his conviction that the result depends both upon mechanical and chemical considerations.

He calls attention to the neglected fact that the prolonged action of boiling water upon wool is injurious. He mentions that wool which looked quite bright after washin luke-warm water was decidedly duller when kept for some time in water at 160° F., and after treatment in boiling water it became quite dull and lustreless,—the *rationale* of the change being perfectly evident on microscopic examination. Hence the author refers to attempts which have recently been made to dye woollens in a vacuum,—a subject to which inventors would do well to direct their efforts. In experiments made at Huddersfield the dye is said to have been absorbed more evenly, more rapidly, and at a lower temperature than in open vessels.

In thus breaking off our notice of a work, of which it is impossible to speak too highly, we must add that it is plentifully illustrated and provided with a good table of contents, index, and with a glossary of technical terms.

CORRESPONDENCE.

PREPARING PLATINUM VESSELS.

To the Editor of the Chemical News.

Sir,—If "G. T. H." will carefully re-read my note on this subject in vol. li., p. 181, I think he will fail to find any claim to novelty therein. Although the method is original so far as I am concerned, and first used by me within the last year, I failed to find any mention of it in the better known authorities on the subject, and it is assuming too much to expect everyone to be conversant with the "dodges" in use in *a* particular laboratory.

To the readers of the Chemical News, however, G. T. H's confirmation of the complete success of the method described by me will no doubt be of value.—I am, &c.,

J. W. Pratt.

Liverpool, May 16, 1885.

FERRICYANIDE OF MANGANESE.

To the Editor of the Chemical News.

Sir,—I stated in my former letter (Chemical News, vol. li., p. 164) that ferricyanide of manganese is soluble in hydrochloric acid. Permit me to say, in reply to Mr. Draper (Chemical News, vol. li., p. 226), that the term soluble may mean with decomposition or without decomposition; the present is an instance of the former.

I beg to refer your correspondent to Fresenius's "Quantitative Chemical Analysis" (Ninth English edition, pp. 113 114) where he will find the word used in the same sense. —I am, &c.,

L. M. Deane,
Assistant Analytical Chemist, Sir W. G. Armstrong, Mitchell, and Co., Newcastle-on-Tyne.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

Note.—All degrees of temperature are Centigrade unless otherwise expressed.

Comptes Rendus Hebdomadaires des Séances, de l'Académie des Sciences. Vol. c., No. 17, April 27, 1885.

On the Combustion of Detonating Mixtures formed with Coal-Gas.—A. Witz.—The exact knowledge of the combustion-heat of coal-gas enables us to determine the temperatures and the theoretic explosive pressures of detonating mixtures formed with this gas. The mixtures were taken at zero and at the atmospheric pressure. A mixture of 1 vol. of gas and 6 vols. of air gave a temperature of 2064° and a pressure of 8·6 atmospheres. A mixture of 1 vol. gas with 10 vols. of air gave the temperature of 1514°, and the pressure of 6·5 atmospheres. These figures are lower than those hitherto admitted.

Researches on the Phosphates.—H. Grandeau.—In a former note the author has shown that the action of an excess of potassium sulphate upon the phosphates differs according to the temperature, and may give rise either to a phosphate or to an oxide. The chemical composition of the product obtained varies also with the nature of the base of the phosphate. By this reaction the phosphates may be divided into three distinct groups. The first group comprises calcium, magnesium, zinc, and cadmium phosphates. Whatever is the temperature, they yield only a single product, a double alkaline phosphate. To this group may be further joined barium and strontium phosphates, which differ merely by the circumstance that the double alkaline phosphate is never obtained quite free from barium or strontium phosphates. In the second group are found phosphates which produce simultaneously a double alkaline phosphate and an oxide. These are aluminium, glucinum, zirconium, iron, nickel, cobalt, and copper phosphates. An important subdivision of this group includes manganese, chrome, and uranium phosphates, which yield a double alkaline phosphate, a crystalline oxide, and a salt—manganate, chromate, or uranate. The third group includes cerium and didymium phosphates which do not combine with potassium at any temperature. They yield a tribasic phosphate and a crystalline oxide.

Oxidation of Iodine in Natural Nitrification.—A. Müntz.—Potassium iodide, during nitrification, gives rise to iodic acid and to lower oxides of iodine, just as nitrites are produced simultaneously with nitrates. The iodate which exists in South American nitres may be regarded as formed during nitrification at the expense of the iodine, the presence of which during the phenomenon of oxidation, which has transformed the nitrogenous organic matter, is interesting as regards the formation of these deposits. Just as certain microbia can oxidise iodine, others can take away oxygen from iodic acid. This reduction is effected in non-aërated media under the same conditions as the reduction of the nitrates.

Dimorphism of Tellurous Anhydride and on some of its Combinations.—D. Klein and J. Morel.—Tellurous anhydride may be obtained in the crystalline state in two distinct forms accordingly as we operate by the wet or the dry way. By the former method it is produced in octahedral crystals of sp. gr. 5·67. In the dry way it yields orthorhombic prisms of sp. gr. 5·90. The authors further describe basic tellurium nitrate, potassium hexa-tellurite, tellurium phosphate, and double tartrates and citrates of tellurium, and of potassium, sodium, and lithium, resembling tartar emetic in their constitution.

Chemical Constitution of Cocaine.—G. Calmels and E. Gossin.—The authors conclude that cocaine, ecgonine, and isotropine are derived from ethyl-tetra-hydro-pyridine, just as tropine is derived from methyl-tetra-hydro-pyridine. Isotropine is the methol-ethyl-tetra-hydro-pyridine; ecgonine is the carbonic acid of methol-ethyl-tetra-hydro-pyridine; cocaine, a diether of the former, is methylic benzo-methol-ethyl-tetra-hydro-pyridine carbonate.

No. 18, May 4, 1885.

Regulation of the Velocity of Electric Motors.—M. Marcel Deprez.—This memoir cannot be intelligibly reproduced without the accompanying diagram.

Suppression of the Nitrous Vapours in the Bunsen Battery, and on a New Battery Depolarised by the Air.—A. d'Arsonval.—The author shows that the method proposed by M. Dupré,—the addition of potassium bichromate to the nitric acid,—is not novel, having been recommended by Ruhmkorff as far back as 1869. Its efficacy is merely temporary, *i.e.*, until all the chromic acid has been decomposed. M. d'Arsonval uses in preference, instead of nitric acid, Poggendorff's mixture, potassium bichromate and sulphuric acid. The great fault in the Bunsen battery is the waste of the nitric acid, of which only 13 per cent is utilised. The author uses, in a flat Bunsen element, in place of the nitric acid, in contact with the carbon, a solution of cupric chloride in hydrochloric acid, which is constantly regenerated by means of the oxygen of the air.

Moniteur Scientifique, Quesneville.
Vol. xv., May, 1885.

New System of Lighting.—M. Helouis.—The author has devised a process for burning the heavy oils of petroleum or coal-tar in a pulverised condition. The light obtained is very white. For an illuminating power of 35 carcels the hourly consumption is 1 kilo. of the heavy oil, costing 10 centimes.

Industrial Society of Mulhouse.—March 11, 1885.—The secretary read a note by M. O. Breuer on the use of white starch in powder in place of pipe-clay for resists on silks and woollens. He then handed in two memoirs sent in candidature for the prize; one on a new method of bleaching by means of "alkaline calcium phosphate," and the other on the action of light upon artificial colouring matters fixed by various procedures.

M. Noelting presented a series of small researches which had been conducted in the laboratory of the Chemical School.

List of Patents taken Abroad.—A series of abstracts of the specifications of chemical patents.

Patents taken in France for Chemical Manufactures.

Selection of Patents having Reference to the Chemical Arts.—Two series beginning with February in the present year, and giving merely the titles of the patents.

Blood-poisonings Due to the Absorption or Resorption of Septic Poisons.—In this memoir, which is of a medical rather then of a chemical scope, the author divides the malignant affections in question into two classes; those in which poisons generated outside the human body penetrate into the organism through the digestive canal or through a wound, and secondly putrid autotoxæmias due to the action of ptomaines formed in the digestive organs. Under the first class he places the so-called allantiasis due to the consumption of putrescent sausages, and the less known affections springing from the use of salt fish, fish preserved in vinegar, and from cheese in certain states of putrefaction. The action of ptomaines produced within the living organism is discussed at some length. The author (Dr. A. Netter) points out that all the products of putrefaction have been analytically demonstrated in the contents of the intestines, *i.e.*, in addition to hydrogen, nitrogen, hydrogen sulphide, carbon dioxide (and gaseous hydrocarbons ?), the fatty acids, such as the butyric and valerianic, nitrogenous bodies, such as leucine, tyrosine, glycocoll, indol, skatol, aromatic products (phenol and skatol), and bodies similar to the alkaloids, some fixed and others volatile. The origin of some of these bodies is not putrefactive. Tyrosine and leucine may result from the action of trypsine, the soluble ferment of the pancreas. Glycocoli and its derivatives are poured into the intestine along with the bile. Cholesterine and its derivative stercorine, excretine, and excretoleic acid have also a biliary origin. Indol, phenol, skatol, and the alkaloids are bodies whose presence demonstrates the occurrence of putrefaction. The dialysable part of the fæces is eminently poisonous. These products of intestinal putrefaction pass into the blood and are detected in the urine. Thus urinary indican expresses the indol absorbed in the bowel and oxidised during its passage through the blood. Phenol appears in the urine as phenyl-sulphuric acid, whilst skatol, cresol, &c., are found there as sulpho-conjugated products.

Japanese Raw Materials for the Manufacture of Ultramarine.—K. Iwabuchi.—From the Chemical News.

Elementary Composition of Nitroglycerine.—Drs. Matthew Hay and Orme Masson.—From an English source.

The Petroleum Industry in Russia.—Boverton Redwood, F.C.S.—From the *Journal of the Soc. Chem. Industry.*

On Amyl Nitrite.—Dr. Squibb.—From the *Pharmaceutical Journal.*

Review of Chemical Researches.—M. G. de Bechi. —Abstracts from the *Berichte d. Deutsch Chem. Geselsch.*

The Action of Aniline upon Mannite.—Dr. J. Effront. —The principal products obtained are mannitane, α-naphthylamine, and a base boiling at 275° to 280°, which does not form crystalline salts. With oxidising agents it forms colouring matters distinct from those yielded by naphthylamine. The author is continuing this research, and purposes studying the behaviour of mannite with the homologues of aniline.

New Method for Measuring the Combustion-heat of Chlorine and of Organic Compounds..—MM. Berthelot and Vieille.—From the *Comptes Rendus.*

Recent Improvements in Tissue Printing.—Dr. O. Witt.—The author describes the origin and properties of oxy-cellulose; the use of chromium sesquichloride as a mordant for the fixation of certain coal-tar colours, and the effects produced by treating manganese bronzes with the aromatic amines.

Justus Liebig's Annalen der Chemie.
Vol. ccviii., Part 2.

Caffeine-methyl-hydroxide and its Fission Products. —E. Schmidt and E. Schilling.—An account of caffeine-methyl-iodide, caffeine-methyl-hydroxide, and its behaviour with sulphuric acid, with water, with chromic acid, with nitric acid, with potassium chlorate and hydrochloric acid, with bromine and barium hydroxide, also caffeine and methyl-caffuric acid.

Conversion of Lactonic Acids into Lactones, and Action of Sodium Ethylate upon Iso-caprolactone.—H. Erdmann.—The author examines the behaviour of sulphuric acid with the lactonic acids, the conversion of phenyl-paraconic acid into phenyl-butyrolactone, the conversion of terebic acid into iso-caprolactone, the action of sodium alcoholate upon iso-caprolactone, pseudo-pyroterebic acid, the properties and reactions of iso-caprolactoide, and of iso-caprolactoid with baryta-water.

Communications from the Principal Chemical Laboratory of the University of Tübingen.—These comprise:—Comparative researches on the chemical behaviour of aromatic and of fatty diamines, by E. Lellmann and E. Würthner; a memoir on a new nitrotoluidine, by the same authors; a paper on a new toluylendiamine, by E. Lellman; a memoir on general methods for determining the constitution of aromatic diamines, and a paper on the constitution of the three dinitroparaxyloles, by the same author.

On the Derivatives of Triphenyl Carbine-bromide. —A. Kölliker.—A sequel to the author's inaugural dissertation.

Bulletin de la Société d'Encouragement pour l'Industrie Nationale. 3rd Série. Tome xii., February, 1885.

Report presented by M. Troost on behalf of the Committee of the Chemical Arts, on L. Kessler's Procedures for Hardening, Polishing, and Colouring soft Calcareous Stones.—M. Kessler, having first coated the stone with solutions of potassium silicate, saturates it with a solution of hydro-fluosilicic acid.

Chemical Composition and Alimentary Value of different Portions of the Grain of Wheat.—Aimé Girard.—The author concludes that it is advisable to reject, in as far as it is mechanically practicable, the outer layers of the grain of wheat, and reserve for human alimentation merely the farinaceous portion.

Cosmos les Mondes.
No. 11, April 13, 1885.

Potassium Permanganate and the Venom of the Viper.—G. Baldoni.—The author concludes that at low temperatures the venom of the viper is almost inoffensive, even for warm-blooded animals of low resisting power. Permanganate is impotent for combating the evil effects of the bite. The recovery of the animals experimented upon is due not to the permanganate but to the insufficiency of the poison.

The Sewage of Paris.—At a meeting of the Society of Public Medicine and Hygiene it was decided that if the drainage of Paris is to be turned into the Forest of St. Germain all fœcal matters must be excluded.

Bacteriology.—A special chair for this doctrine is to be instituted at the Sorbonne.

No. 12, April 20, 1885.

Danger of the Fumes of Nitric Acid.—Several cases of poisoning by these vapours have been observed in the hospitals of Bonn and Halle. According to *l'Electricité*, a girl who was carrying along the street a metal vessel of nitric acid inhaled the fumes and died in twelve hours of asphyxia. A young chemist who had been working for some time with fuming nitric acid was gradually poisoned, and his recovery was very tedious. It is recommended that batteries, such as those of Bunsen, &c., should not be used where there is defective ventilation.

Adulteration of " Pain d'Epices."—This esculent is now, it appears, manufactured of glucose, tin chloride (!), and potash, and is glazed, not with white of egg, but with " colle de Paris."

No. 13, April 27, 1885.

This number contains no chemical matter.

Bulletin de la Société Chimique de Paris.
Vol. xliii., No. 3, Feb. 5, 1885.

Action of Sulphuric Acid upon Cyanogen Iodide. —E. Gossin.—The decomposition of cyanogen iodide takes place completely even in the cold.

The Formation of Ptomaines in Cholera.—A. Villiers.—The author demonstrates the formation of alkaloids of this class in the living body during certain diseases, which then terminate as veritable poisoning cases.

A Modification of Tissandier's Apparatus.—Ch. Cloez.—This paper requires the accompanying figure.

The Oxidation of Homonicotianic Acid and Partial Synthesis of Cinchomeronic Acid.—Oechsner de Coninck.—Homonicotianic acid is one of the toluic acids of the pyridic series, and it can be transformed into cinchomeronic acid by the action of potassium permanganate.

Session of the Russian Chemical Society.— May 3/15, 1884.—M. Mendelejeff discussed the relation between the module of expansion and the absolute temperature of ebullition. He also communicated the results of his studies on the density of the normal hydrate of sulphuric acid. He finds that the sp. gr. of H_2SO_4 given by Kohlrausch, Lunge, and Naef is inaccurate, whilst that of Marignac is correct to 0·0001. M. Mendelejeff also made known his researches on the distillation of American petroleum.

M. Prjybytek described a new oxide of the series $C_4H_{2n} - 2O_2$.

M. Kabloukoff announced that the glycide of hexylic glycerin may be obtained by treating the acetic ether of butallyl-methyl-carbinol by hydrous hypochlorous acid and then with a strong potash lye.

M. Kanonnikoff replied to Flavitsky's observations concerning his memoir on the relation between the composition and the refractive energy of substances.

M. Wittenberg sent in researches on azo-phenyl-acetic acid.

M. Chechoukoff has obtained isobutylene chloride by the action of strong hydrochloric acid upon isobutenyle chloride. He described also a pseudobutylene chloride.

M. Kolotoff has studied the action of the mono-, di-, and tri-ethylamines and of aniline upon oxymethylene.

M. Fistchenko finds that on heating oxymethylene with dilute hydrohaloid acids there are formed formic acid and methylic alcohol. He has also obtained normal propylic and butylic alcohols by the respective action of $Zn(C_2H_5)_2$ and $Zn(C_3H_7)_2$ upon oxymethylene.

M. Favorsky is continuing the researches of Almedingen on the condensation of the crotonylenes.

MM. Lwoff and Chechoukoff by the action of weak muriatic acid upon iso-propenyl-carbinol at common temperatures have obtained, besides the isomeric transformation-product, an intermediary product, isobutyleneglycol.

M. Iloupotsky has obtained from the action of chlorine upon tetra-methyl-ethylene the compound $C_6H_{11}Cl$, boiling at 113°—115°.

M. Lwoff made some observations on the general schemes of double decompositton with reference to the succession of reactions.

M. Boutleroff described his researches on azarone.

M. Melikoff sent in an investigation on the glycidic acids.

MM. Hemilian and Silberstein described triphenyl-amido-methane and analogous compounds.

MM. Menschoutkine and Konovaloff have studied the decomposition and dissociation of gaseous bodies. They find that pulverulent bodies, *e.g.* asbestos, greatly accelerate decomposition.

M. Potilitzine sent in researches on the displacement of chlorine by bromine, criticising the explanations given by Berthelot.

M. Berade communicated a paper on the solubility of lithium carbonate, which decreases up to 100°, and increases again at higher temperatures.

M. Mikailoff discussed animal colouring matters, and a new reaction of the albumenoids containing nitrogen and sulphur. On adding such a substance to a solution of ferrous sulphate, and treating the mixture with strong sulphuric acid and a minimum of nitric acid, there are seen along with the well-known brown rings of ferric oxide rings of a blood-red colour of iron sulphocyanide.

M. Goloubeff presented the results of the determination of chlorine and sulphuric acid in the waters of the Neva.

M. Tschelzoff discussed the theory of the mechanical wave formed on detonation.

The fifth part of vol. xvi. of the *Journal of the Russian Chemical Society* contains memoirs on the alizarine oils, by M. Loukainoff; on the dependence of photo-chemical phenomena on the amplitude of the luminous waves, by M. Timiriazeff; on the action of ethyl iodide upon silver azobenzoate, by M. Goloubeff; on α-naphthoquinone and its derivatives, by M. Miller; on the separation af strontium from calcium by Sidersky's process, by M. Bogolometz. The author concludes that in order to separate strontium from calcium by the mixture of ammoninm sulphate and oxalate, as proposed by M. Sidersky, it is nccessary to work at an elevated temperature. On certain salts of mesotartaric acid, by M. Prjybytek; reply to M. Flavitzky, by M. Kanonnikoff; on triphenylamine and its analogues, by MM. Hemilian and Silberstein. Part six of the same volume contains researches on the products of the reaction of chlorine on the various butylenes, by M. Chechoukoff; the reduction of isodintrobenzyle, by M. Goloubeff; on the succesion of reactions, by M. Lwoff; on the constants of chemical affinity, by M. Ostwald; on the glycidic acids, by M. Melikoff; and on a new apparatus for the determination of specific heat, by M. Louguinine.

Journal für Praktische Chemie
Vol. xxxi., Part 4.

On Albumen and its Oxidation.—Oscar Loew.

Ultramarine Blue in the Igneous Way from Silica, Without Alumina.—F. Knapp.—The author finds it impracticable to obtain this compound by the methods given by Gmelin and Rickmann.

The Preparation of Chrome and Manganese Compounds Analogous to Potassium Ferri- and Ferrocyanides.—O. T. Chistensen.—The author describes potassium chromi-cyanide, potassium mangani-cyanide, and the corresponding chromo- and mangano-compounds.

NOTES AND QUERIES.

⁂ Our Notes and Queries column was opened for the purpose of giving and obtaining information likely to be of use to our readers generally. We cannot undertake to let this column be the means of transmitting merely private information, or such trade notices as should legitimately come in the advertising columns.

Fuller's Earth.—Are there any other purposes in the arts for which fuller's earth is used besides that of cleansing cloth? Is it used for purifying oils?—Kosmo.

MEETINGS FOR THE WEEK

Tuesday, 26th.—Royal Institution, 3. "Digestion and Nutrition," by Prof. Gamgee.
—— Royal Medical and Chirurgical, 8 30.
Wednesday, 27th.—Geological, 8.
Thursday, 28th.—Royal Institution, 3. "Poisons," by Prof. C. Meymott Tidy.
Friday, 29th.—Royal Institution. 8. "Mechanical Production of Cold, and Effects of Cold on Microphytes," by Mr. J. J. Coleman and Prof. McKendrick, at 9.
Saturday, 30th.—Royal Institution, 3. "The Teaching of the Twelve Apostles"—an Ancient Document—with Illustrations from the Talmud, by the Rev. C. Taylor.

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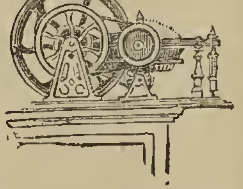

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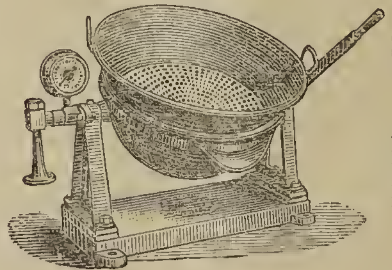

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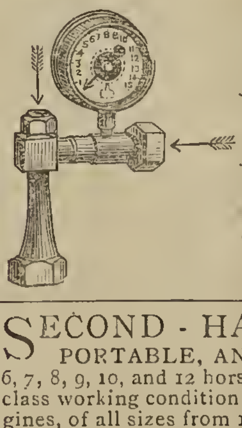

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THE CHEMICAL NEWS.

Vol. LI. No. 1331.

RECENT RESULTS WITH REGARD TO BY-PRODUCTS OBTAINED IN COKING COAL IN THE SIMON-CARVÈS COKE OVENS.*

By WATSON SMITH, C.E.
Lecturer in Technological Chemistry in the Victoria University, Manchester.

It will be fresh in the memory of those present at the Chester meeting of the Iron and Steel Institute of last year, that the analytical results I obtained of the tar from the Simon-Carvès coke ovens as worked at Pease's West, near Darlington, showed that this tar was poor in benzenes, very poor in carbolic acid, but extremely rich in naphthalene and anthracene. The oils commonly known as "creosote oils of tar" (containing largely methylated naphthalenes and phenols, together with naphthols perhaps) are present in comparatively small quantity, and the so-called "anthracene oils" or "red oils" are deficient in quantity. (See *Journal of Iron and Steel Institute*, 1884, No. 2, pp. 509—512.) Now, in view of the fact that a large company (the Bear Park Company) has recently started operations with fifty of the Simon-Carvès coke ovens with improved recuperating arrangements, and at the same time with a different class of coal to that used by Messrs. Pease, it will be interesting to see what results have been obtained by this new firm in the direction of the recovery of by-products. There is no doubt that the temperatures attained in the Bear Park ovens are, if anything, higher than those at Pease's West.

We have, then, other conditions remaining the same, somewhat higher temperatures, and a different coal. The subjoined analyses will show the differences of the coal-tars obtained—(I.) at Messrs. Pease's, and (II.) at the works of the Bear Park Company.

The above determinations prove that the tar obtained from the Bear Park ovens much more closely resembles normal gas-retort coal-tar than that obtained from the coke ovens at Pease's West. It is generally richer in benzenes and carbolic acid, and though less rich in naphthalene and anthracene it is nevertheless still a tar very rich in these substances.

There is no doubt that in the English works employing the Simon-Carvès oven, condensation is still imperfect, and the methods for most efficiently recovering tar and ammonia are not much beyond the stage of infancy, so that it is somewhat premature as yet to attempt to set bounds to the value of the Simon-Carvès ovens as producers of coal-tar and ammonia. Though the price of benzene is now down again, yet it should not be forgotten that it has been up to prices between 14s. and 16s. per gallon now twice in sixteen years, and not the benzenes only, but all the other tar products, rose to high figures on both occasions. Ammonium sulphate sustained also similar elevations and depressions.

With respect to the employment of very high temperatures in carbonising coal in closed vessels, I am told on good authority, and this is an interesting fact, that those who are engaged in carbonising coal in retorts more of the gas-works kind, for the sake mainly of the by-products, amongst which especially the benzenes, have found that when precautions are adopted for absorbing by means of oils, with and without simultaneous refrigeration, the benzene from the gas made, that the total benzene made increases in proportion to the increase of temperature employed in carbonising—in fact, that practically the very highest temperatures they can employ are the best for benzene production. Hence there is one example of something that remains to be done yet to increase the yield of benzenes—at present less than it should be—and also an indication that much more may be done, if chemical as well as engineering skill play its part to the full.

Whatever changes may be effected in the future as the result of scientific research, with regard to the more advantageous treatment of coal at high temperatures for the obtainment of aromatic hydrocarbons, &c., valuable for the manufacture of dyes and colours more especially, one thing is certain, viz., that so far as the present is concerned the only and hence the best conditions, whether rational or irrational, for obtaining such aromatic bodies in the most favourable proportions, are—a bright red-heat applied to a close vessel containing the fuel, and therefore applied externally, and, moreover, applied so that the fuel may be heated throughout its mass as evenly as possible, hence necessitating its arrangement in as thin a layer as possible between the heated walls of the retort or oven, and that the vapours of the generated products be withdrawn from the heated interior as rapidly as practicable. These conditions are obeyed alike in the retorts of the gas-manufacturer and in the Simon-Carvès coke ovens, and in both cases similar valuable products are obtained.

In comparing coal-tars, of course it must be remembered that these tars may give very different results on distilling and fractionating as regards the proportion of constituents present, according to the effectiveness or otherwise of the condensing or cooling arrangements employed in the works at one time or another, other circumstances and conditions remaining the same. If cooling is deficient, the benzenes are more or less carried off in the gas, and a thicker tar apparently richer in the other and more solid products remaining behind is obtained.

I regard the tar obtained at present in the works of the Bear Park Company as equal to the best Lancashire coal-tars. I am informed that as regards proportion of tar obtained on the coal carbonised, the Bear Park Company have also an increase over that proportion obtained elsewhere. One difference from ordinary gas-retort tar is observable even in the Bear Park product, viz., that the carbolic acid is less in amount in this latter tar, viz., about 0·3 per cent against about 0·5 per cent as the lowest average from the ordinary gas-retort. I think this less quantity of phenols is due to the fact that the tar vapours in the Simon-Carvès ovens have to pass through a very considerable mass of superincumbent coke at a very high temperature, and the rate of aspiration from the highly heated atmosphere of the ovens is comparatively and of necessity very slow.

A German chemist, K. E. Schulze (*Ann. Chem.*, Bd. 227 [1 and 2], p. 143), has recently stated the view that the primary products of the dry distillation of coal are phenols. These phenols by the further action of heat in retorts or ovens are, he believes, split up so as to yield water on the one hand, and on the other high boiling hydrocarbons, whilst another portion of them is reduced to lower boiling hydrocarbons, or finally with entire decomposition, are converted into illuminating gas. Schulze separated from the anthracene oil various high boiling bodies of the phenol-type, and amongst others α and β naphthol. He found also that by distilling the higher phenols he obtained from anthracene oils, he obtained liquid hydrocarbons in part, with separation of water.

Now, if Schulze's theory be correct, and phenols are primarily formed on the distillation of coal, then with a lower distilling or carbonising temperature we might expect to obtain tars richest in phenols, and at more elevated temperatures the phenols should diminish and hydrocarbons proportionately increase. Well, we do find the phenols diminish, as witnessed in the case of both Pease's and the Bear Park tars; but, on the other hand,

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* Read before the Iron and Steel Institute.

I. PEASE'S TAR.

Messrs. S. A. Sadler and Watson Smith.

	Per cent.
Light oils	4·5
Creosote oils, with much naphthalene	20·4
Very thick anthracene oils	34·2

Further treatment of the distillates gave—

	Per cent. on tar.
Water	10·00
50 per cent benzol	0·50
Solvent naphtha (90 per cent at 160° C.	0·60
Heavy naphthas	0·40
Crude carbolic acid	0·05
Creosote oils	46·50
Anthracene	0 74
Pitch and loss	41·21
	100·00

Specific gravity of tar = 1·106

II. BEAR PARK TAR.

(a.)
Dr. Ernst Wirth
(Accrington).

	Per cent.
Light oils	5·12
Creosote oil	7·44
Thick anthracene oil	34·03
Naphtha	3·05
Pitch	45·17

Further treatment gave—

	Per cent. on tar.
50/90 per cent benzol	0·703
Solvent naphtha, 90 per cent	1·031
Burning naphtha, 30 per cent	0·434
Carbolic acid (crude)	0·305
Cresol (crude)	0·352
Anthracene, 28 p. c.	2·396

1 ton of tar yields 1·44 gallons 50 per cent benzol, and 48·2 lbs. anthracene of 28 per cent.

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(b.)
Messrs. P. A. F. Sadler
and Watson Smith.

	Per cent,
Light oils	5·12

	Per cent. on tar.
Benzol, boiling 80° to 100°	0·53
Toluol, boiling 100° to 120°	0·29
Solvent naphtha	1·25
Burning naphtha	0·20
Crude naphthalene, with some creosote oil	1·00

Specific gravity of tar = 1·15

(c.)
Messrs. P. A. F. Sadler
and Watson Smith.

	Per cent.	
Ammoniawater	7·44	
Light oil	6·28	
Heavy oil (creosote)	11·99	21·16
Naphthalene (crude)	10·17	
Thick anthracene (crude)	11·57	
Rather soft pitch	57·29	

The crude carbolic acid was much more rich in quantity than in Pease's tar, and our quantitative observation, though not exactly made, goes to confirm Herr Wirth's result. The quality of the carbolic acid was good.

Specific gravity of tar = 1·15

let us see what takes place when distillation is carried on at low temperatures with shales or cannel coal, as in the Scotch paraffin industry. Tars are then obtained rich in paraffins, but *poor* in phenols. Now, this does not seem at first sight to bear out Schulze's theory, unless we consider, as indeed may be the case, that the points of temperature at which a maximum yield of phenols is obtained, and that at which they decompose to yield hydrocarbons, lie somewhat near together, and that the temperatures employed in the distillations in the paraffin industry are, in the main, below those necessary to produce aromatic substances, and amongst them phenols.

It seems to me very probable that in contact with red-hot carbon, simple reduction of phenols may also take place with formation of carbonic oxide and hydrocarbons; at the same time certainly more or less total disruption of the phenols takes place, according to the elevation of temperature, with separation of carbon.

Quite recently Victor Meyer, of Zürich, has discovered a homologous series of new compounds containing sulphur in addition to hydrogen and carbon, viz., the thiophens. These bodies accompany the benzenes, and until Meyer's discovery it was not known that all so-called chemically pure benzene prepared from tar always contained this thiophen, with a boiling-point similar to that of benzene. I have examined the benzene distilling constantly between 80° and 82° C. and prepared from the tar from Messrs. Pease's works (Simons-Carvès coke ovens), and I find this benzene to be very rich in thiophen, by comparing the indophenin reaction obtained with it with the reaction obtained with other benzenes, from which it would seem clear that a high temperature, and exposure to prolonged contact with red-hot coke, rather favours than otherwise the production of thiophen. Some sixteen years ago, I found that the light shale napthas or spirit obtained in the works of the Young Paraffin Light Company, contain certain quantities of benzene and toluene, and the thought now occurred to me to try to separate as far as possible, by fractional distillation, a quantity of the benzene contained in some of this shale spirit, and to test this by the indophenin reaction, and thus try to discover if the temperatures of carbonisation employed in preparing shale-tars, at which the members of the benzene series just begin to make their appearance, are sufficient also for the incipient production of thiophen. I found on applying the test no trace of thiophen present with the benzene from the shale spirit. This crude benzene still contained foreign hydrocarbons, however, which could not be separated by fractional distillation.

The experiment would appear to show that the temperature of formation of thiophen lies higher than that necessary for the formation of benzene; and it is possible then that a carbonising temperature might be adopted at which benzenes are produced more or less free from the thiophens. I believe that a most important field of chemical technological research still lies fallow in which the more exact thermometric conditions must be observed and registered necessary for ascertaining more precisely the more exact higher and as yet unobserved thermal conditions under which certain not only important chemical but also physical changes take place. Advance is being made in this direction, and mercurial thermometers can now be purchased in Germany, at a reasonable cost, for exactly observing temperatures as high as 500° C. (932° F.) Some very interesting accounts of such high-temperature thermometers will be found in the *Journal of the Society of Chemical Industry* for January of this year.

In my paper read before this Institute in Chester last year, I stated that no attempt had yet been made, so far as I was aware, to adapt the Appolt coke oven for the recovery of by-products. Since that time I have heard that two Austrians, Messrs. Maderspach and Siersch, have patented such an adaptation. These inventors propose to use a similar alternative heating arrangement to that adopted by Otto in the case of his coke ovens, viz., two Siemens regenerators, one at each end; so that whilst one is acting as escape-flue for the spent heat and furnace gases, the other, still hot, is acting as regenerator for the air subsequently to mix with return gas for combustion around the oven walls.

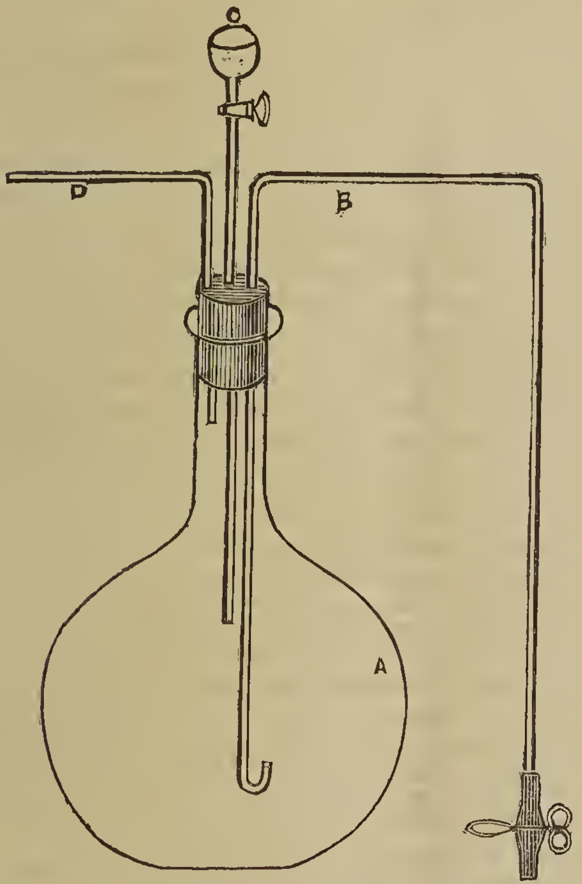
Seeing that there is no bottom flue for heating these ovens, and hence that the whole stress of heat is confined to the side flues—these side flues, the most difficult to get at and repair in a battery of such ovens, will, other things being equal, be more frequently in need of repairs, through the greater concentration of heat necessary to produce the same results. Other ovens with bottom flues as well as side flues will stand better as a whole, because the heat is more distributed, and so tempered, and the bottom flues receiving the greatest heat, and so first likely to get out of repair, are most easily accessible.

REMARKS ON "THE METHODS OF INDIGO TESTING."

By CHRISTOPHER RAWSON, F.C.S.

Having of late years given considerable attention to the various methods employed for estimating the value of indigo, perhaps I may be allowed to make a few remarks upon the interesting paper by Dr. Rau which appeared in the Chemical News, vol. li., p. 207.

The value of a sample of indigo is determined by the combined percentages of indigotin and indirubin (indigo-red) present. There are reasons to suppose that indirubin possesses a greater tinctorial power than indigotin, and I may say that at the present time I am making experiments in order to ascertain the relative value of the two colouring principles.



Fritzsche's method of reduction is well known as a convenient and reliable mode of obtaining pure indigotin. Since indirubin is soluble in alcohol, it occurred to me that Dr. Rau's modification of Fritzsche's method would also produce pure indigotin, and consequently estimate that constituent only, and yet it is stated that the crystalline precipitate obtained from the alkaline alcoholic solution consists of indigotin and indirubin. In order to put the question to a practical test, I made several determinations of different samples of indigoes by Dr. Rau's method, following his directions in every particular, and the results obtained confirmed the supposition which I had formed. The crystalline precipitates, after weighing, were treated with hot alcohol, and in each case the liquid assumed a pure blue colour. On cooling, the dissolved indigotin separated in blue flakes, leaving the alcohol perfectly colourless. The alcohol was evaporated to dryness, but left no weighable residue. Ether also failed to extract a red colour from any of the crystalline precipitates yielded by various classes of indigoes. These properties alone would indicate that the precipitate produced by Dr. Rau's modification of Fritzsche's method consists of pure indigotin. But, further, I have compared the process with a method devised by myself (*Journal of the Society of Dyers and Colourists*, vol. i., p. 78), which determines the percentage of indirubin as well as indigotin. Dr. Rau's process gave results agreeing with the percentage of *indigotin* yielded by my own method. But the estimation of indigotin is not in itself sufficient for determining the value of a sample of indigo; it is necessary that one should also take into account the percentage of indigo-red or indirubin.

The method which I have proposed is thus performed:— One grm. of finely powdered indigo is ground into a thin paste with water, and introduced into a 40-oz. flask (A) with 500 to 600 c.c. of lime-water. The flask is furnished with an india-rubber stopper, which has three perforations, in one of which is inserted a syphon (B) closed by a pinch-cock, and in another is fixed a funnel (C) provided with a stopcock; the third aperture, by means of a short bent glass tube (D), serves for the entrance of a current of hydrogen or coal-gas. The flask is connected with the gas supply, and the contents heated to about 80° C. 200 to 250 c.c. of a solution of sodic hyposulphite (hydrosulphite) are now introduced by means of the funnel, and the mixture, which in a few minutes takes a yellow tint, is kept near the boiling-point for half an hour. After allowing the insoluble matters in the flask to subside, 500 c.c. are syphoned off, and the rest of the liquid accurately measured. The 500 c.c. are poured into a conical flask, and by means of an aspirator a current of air is drawn through the liquid for about twenty minutes. The excess of hyposulphite is thus oxidised to sulphite and the indigo-white to indigotin. Hydrochloric* acid is then added to dissolve any carbonate of lime which may have been formed, and the precipitate is collected upon a previously dried and weighed filter, washed thoroughly with hot water, dried at 105° C., and weighed. The precipitate thus obtained consists of indigotin and indirubin. In order to determine the amount of each of these constituents the filter with its contents is placed in an extraction apparatus, and the indirubin dissolved by means of alcohol. The alcoholic solution is allowed to cool in order that any indigotin may be deposited, from which it is filtered, evaporated on the water-bath, dried at 105° C., and lastly weighed. The difference between the first weighing and the second gives the amount of indigotin, from which the percentage may be easily calculated.

Example.—One grm. of indigo was reduced by a mixture of sodic hyposulphite and lime-water. The liquid measured 935 c.c.; 500 c.c. were oxidised and treated as above described. Weight of precipitate = 0·243.

$$\therefore \ \frac{0{\cdot}243 \times 935 \times 100}{500} = 45{\cdot}44 \text{ p.c. indigotin and indirubin.}$$

The filter with precipitate was placed in the extraction apparatus, and the indirubin dissolved by means of alcohol. The solution was cooled and filtered from a few flakes of indigotin, evaporated to dryness, and dried at 105° C. Weight of alcoholic extract = 0·0135.

$$\therefore \ \frac{0{\cdot}0135 \times 935 \times 100}{500} = 2{\cdot}52 \text{ per cent indirubin.}$$

Indigotin (by difference) = 42·92 per cent.

The sodic hyposulphite solution used in the above process is easily and readily prepared as follows:—A flask of about 200 c.c. capacity is loosely filled with twisted sheet-zinc, which is covered with a solution of sodium bisulphite (sp. gr. 1·30). The flask is corked, and allowed to stand for about an hour, when the solution

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* When hydrochloric acid is added to sodic hyposulphite a copious precipitate of sulphur occurs, but after oxidising the liquid by a current of air the solution remains perfectly clear on the addition of an acid.

should have lost the smell of sulphurous acid. The liquid is now decanted, and well mixed in a flask or bottle with 3 litres of water, containing in suspension about 80 grms. of recently slaked lime. The vessel is provided with a cork, through which pass two tubes, one in the form of a syphon, and the other, which reaches just below the cork, is connected with a supply of coal-gas. The insoluble matters quickly subside, when the clear liquid may be syphoned off as required. Three months after the sodic hyposulphite has been thus prepared I have found the reducing power of the solution to be but little diminished.

Regarding the oxidation processes for estimating indigotin, I quite agree with Dr. Rau that they all give too high results, but I have rarely obtained figures by the permanganate method as much as 10 per cent higher than the true percentage of indigotin, nor, at the most, 5 per cent higher than the combined percentages of indigotin and indirubin. Dr. Rau, in his paper, quotes the following examples:—"A good Bengal indigo which actually contained 52·5 per cent indigotin showed 72·5 per cent when tested by the permanganate process, and a Kurpah of 41·8 per cent by the same test yielded 69·2 per cent." It appears to me that such a very great difference could only have been caused by titrating the unfiltered solution with potassium permanganate. Experiments which I have made upon this subject (*Journal of the Society of Dyers and Colourists*, vol. i., p. 75) show that the inaccuracy of the permanganate method (as well as other oxidation processes) is due to the presence of substances soluble in hydrochloric acid, and very considerably to iron in the ferrous state. Indigo-brown, which is soluble in caustic alkalies, dissolves in concentrated sulphuric acid with a deep dark brown colour, but on the addition of water it is almost entirely precipitated; so that this constituent of indigo can have no appreciable effect upon the permanganate method. Indirubin acts upon potassium permanganate in a similar manner to indigotin, which property is much in favour of the permanganate method, since indirubin plays an important part in indigo dyeing, and consequently should be estimated as well as indigotin.

I have modified the permanganate method so that the error caused by the presence of substances possessing no tinctorial value is eliminated. About 1 grm. (0·5 to 1·25) of the finely powdered indigo is intimately mixed in a small mortar with its weight of ground-glass. The mixture is gradually and carefully added during constant stirring with a glass rod to 20 c.c. of concentrated sulphuric acid (sp. gr. 1·845) contained in a porcelain crucible (1½ ozs. capacity.) The mortar is rinsed out with a little powdered glass, which is added to the contents of the crucible, and the whole is exposed for a period of one hour to a temperature of 90° to 95° C. The sulphindigotic acid thus formed is diluted with water and made up to 1 litre. By this mode of treatment experience has shown that all the indigotin is thoroughly dissolved, whilst the filtered solution is freer from foreign bodies than when some of the older methods of solution are employed. The solution is filtered, and 50 c.c. of the filtrate are mixed in a small flask with 50 c.c. of water and 32 grms. of common salt. The liquid, which is thus almost saturated with salt, is allowed to stand for two hours, when it is filtered, and the precipitate washed with 50 c.c. of a saturated solution of salt. The precipitate is dissolved in hot water, and when cool mixed with 1 c.c. sulphuric acid and diluted to 300 c.c. To this dilute solution standard permanganate (0·5 to 1 litre) is gradually added until the liquid, which at first takes a greenish tint, changes to a light yellow. The end of the reaction is sharp and unmistakable. It is necessary to make a slight correction in order to allow for the small quantity of sodium sulphindigotate, which dissolves in a saturated solution of sodium chloride. This correction I have found in my own experiments to be 0·0008.

On reference to the appended table it will be observed that results obtained by this modified process agree on the whole very closely with the combined percentages of indigotin and indirubin. It is important in testing indigoes by this method that the dilution should in all cases be as near as possible the same.

Table showing Permanganate Methods in comparison with the True Percentage of Indigotin and Indirubin.

	Variety of Indigo.	Permanganate Method.		Reduction Method. Hyposulphite & Lime.	
		(Direct.)	(Modified.)	Indigotin.	Indirubin.
I.	Java	76·18	73·55	68·97	4·23
II.	Bengal	66·71	63·50	59·12	3·50
III.	Bengal	62·66	57·50	56·20	2·80
IV.	Oude	50·04	44·90	43·42	2·65
V.	Kurpah	47·15	43·10	42·68	2·45
VI.	Madras	39·50	37·40	35·21	3·75

Marsh Field Dye Works, Bradford.

INFLUENCE OF BILE, BILE SALTS, AND BILE ACIDS ON AMYLOLYTIC AND PROTEOLYTIC ACTION.*

By R. H. CHITTENDEN and GEO. W. CUMMINS.

The influence of bile and bile acids on the digestive processes of the intestinal canal has long been considered an important one, still few experiments have been made to determine the exact influence of these substances by themselves on ferment action. The form in which the main constituents of the bile exist in the intestinal canal depends naturally upon the reaction of the contents of the intestines. If these have an acid reaction, bile acids must be present; if alkaline, salts of these acids; and it is fair to presume that under these two conditions the presence of bile may be productive of different effects on ferment action. Recorded observations tend to show that ordinarily the contents of the intestines possess a distinct acid reaction; thus Schmidt-Mülheim† has found that in dogs fed on albuminous matter the contents of the small intestines are invariably acid, although the mucous membrane sometimes possesses an alkaline reaction. It is evident that in such cases the alkali of the bile must have combined with the acid of the chyme, which would be followed by liberation of the bile acids and partial precipitation of the same in combination of the proteid matters of the chyme. Moreover, the recorded observations of Schmidt-Mülheim tend to show that this acid condition of the contents of the intestines persists throughout the entire length of the intestinal canal. Uffelmann‡ has likewise found, in corroboration of the above, that the fæces of infants naturally nourished possess a weak acid reaction, while, on the other hand, Nothnagel,§ as a result of 800 observations, finds that human excrement, in the case of adults, varies decidedly in its reaction, being generally alkaline, more rarely acid or neutral. It is hardly proper, therefore, to conclude that it is only necessary to study the influence of the bile acids in their free condition on ferment action, since in the passage of the ferments through the intestinal canal there are times, doubtless, when the reaction of the mass is more or less alkaline, especially in the small intestines, for some distance beyond the opening of the bile and pancreatic ducts. In either case it is an interesting point to ascertain whether the bile salts have an action at all analogous in kind or extent to that of the free acids.

Many observations‖ are recorded concerning the duodenal precipitate formed in the duodenum by the action of bile on the acid-reacting chyme. The precipitate itself has generally been supposed to consist of a mixture of

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* Reprinted from *American Chemical Journal*, vol. vii., No. 1.

† *Archiv. für Physiologie.* Du Bois Reymond, 1879, p. 56.

‡ *Jahresbericht für Thierchemie*, 1881, p. 305.

§ *Jahresbericht für Thierchemie*, 1881, p. 309.

‖ See Maly in Hermann's *Handbuch der Physiologie*, 5, 180.

syntonin, peptone, and bile acids, but recent experiments of Maly and Emich* with pure bile acids tend to show that only the non-peptonised albuminous bodies are precipitated, viz., coagulable albumin and syntonin, and these only by taurocholic acid, while peptone and "propeptone" remain in solution. This fact lends favour to the view advanced by Hammarsten, that the object of the precipitation of the albuminous matter on the walls of the intestines is to prevent its too rapid passage through the intestinal canal, thus escaping the full action of the pancreatic juice. The addition of taurocholic acid to a solution of peptone, Maly and Emich find, is followed by the formation of a distinct opalescence or fine dust-like precipitate, slowly changing to fine droplets. This precipitate, however, which is doubtless the same as observed by Hammarsten and Brücke on the addition of bile to portions of a digestive mixture, does not contain, according to Maly and Emich, any peptone, but consists of taurocholic acid, possibly in a modified form.

Both of these precipitations, however, would tend to mechanically throw down, to a greater or less extent, any ferment present, and thus diminish ferment action; but, as Maly points out, the main reason for a diminished action, in the case of pepsin, is to be sought for, not in a precipitation of the ferment, but in the formation of a compound of albumin with the bile acid, not digestible by pepsin-hydrochloric acid. But since this precipitation, as a normal reaction in the animal body, must take place in the intestinal canal, it is equally important to ascertain the extent of its digestibility in pancreatic juice, or, in other words, to ascertain the exact influence of bile and its several constituents on the proteolytic action of trypsin as well as on the action of pepsin and on amylolytic action.

The only data bearing on these points are the recent experiments of Maly and Emich, who have found that 0·2 per cent taurocholic acid hinders the digestive action of pepsin-hydrochloric acid, while 1 per cent glycocholic acid is without influence. The same investigators likewise state that 0·1 per cent taurocholic or glycocholic acid stops the amylolytic action of the pancreas ferment, and that 0·2 per cent taurocholic acid or 1 per cent glycocholic acid will completely stop the amylolytic action of the salivary ferment.

Our experiments on this subject were commenced before the above results were published, and we have continued them, since we wished to ascertain also the influence of the bile salts, and also the effects of both salts and acids, as well as the bile itself, on the proteolytic ferment of the pancreas. The results of Maly and Emich, moreover, not being quantitative, do not express the relative effects of the various percentages of bile acids used, but simply the percentage of acid necessary to stop the ferment action under the conditions described by them.

I. *Influence on Amylolytic Action.*

As amylolytic ferment, we have employed filtered human mixed saliva, made neutral and then diluted to a known volume. In studying the influence of the various percentages of bile salts and acids on the action of the ferment we have used a digestive mixture (50 or 100 c.c.) containing 1 per cent of starch previously boiled with water, and 2 per cent of saliva, together with the given percentages of bile salts or acids. The extent of diastatic or amylolytic action under the varying conditions was determined in each case by estimating the amount of reducing substances, maltose and dextrose, formed during 30 minutes warming at 40° C. Further diastatic action was at once stopped by boiling the digestive mixtures, after which they were diluted to a known volume, and the reducing substances determined in a given portion of the diluted fluid by Allihn's gravimetric method.† The reducing substances are in each instance calculated as dextrose, and the diastatic action is expressed in the percentage of starch converted into sugar.

We first tried the influence of crystallised ox bile, since bile itself contains a small amount of a diastatic ferment. A 1 per cent solution of nicely crystallised ox bile was made, with which the following results were obtained:—

Crystallised bile.	Weight Cu in one-eighth.*	Total amount sugar.	Starch converted.
0 per cent.	0·0643 grm.	0·2636 grm.	23·72 per cent.
0·01 ,,	0·0630 ,,	0·2584 ,,	23·25 ,,
0·02 ,,	0·0686 ,,	0·2804 ,,	25·23 ,,
0·03 ,,	0·0693 ,,	0·2836 ,,	25·52 ,,
0·05 ,,	0·0656 ,,	0·2688 ,,	24·19 ,,
0·10 ,,	0·0734 ,,	0·3000 ,,	27·00 ,,
0·20 ,,	0·0665 ,,	0·2724 ,,	24·51 ,,
0·35 ,,	0·0447 ,,	0·1860 ,,	16·74 ,,

* One-eighth of the entire digestive mixture.

Here it is plain that a mixture of sodium glycocholate and taurocholate, in such proportion as they are contained in crystallised ox bile, exerts no appreciable retarding influence on amylolytic action until present to the extent of 0·35 per cent. On the contrary, smaller percentages unmistakeably tend to increase the diastatic action of the ferment. The solution of crystallised bile had, however, a slight acid reaction, and possibly this may have had some influence in giving the latter results. The saliva and starch were both neutral.

Experiments were next tried with sodium taurocholate alone, and also with sodium glococholate. Following are the results:—

Sodium taurocholate	Weight Cu in one-eighth.	Total amount sugar.	Starch converted.
0 per cent.	0·0787 grm.	0·3212 grm.	28·90 per cent.
0·3 ,,	0·0030 ,,	0·0146 ,,	1·51 ,,
0·5 ,,	0·0023 ,,	0·0112 ,,	1·00 ,,
Sodium glycocholate.			
0·5 per cent.	0·0783 ,,	0·3196 ,,	28·76 ,,

It is thus plainly evident that sodium taurocholate has a very decided action on the amylolytic ferment of saliva, while the same percentage of glycocholate is entirely without effect. The retarding action of the crystallised bile is thus, without a doubt, due wholly to the taurocholate. Moreover, even smaller percentages of sodium taurocholate retard amylolytic action with almost equal energy.

The following results were obtained under like conditions as the preceding, except that the 2 per cent of saliva employed was not neutralised:—

Sodium taurocholate.	Weight Cu in one-fourth.	Total amount sugar.	Starch converted.
0 per cent.	0·0590 grm.	0·1212 grm.	21·81 per cent.
0·14 ,,	0·0079 ,,	0·0192 ,,	3·45 ,,
Sodium glycocholate.			
0·20 per cent	0·0758 ,,	0·1548 ,,	27·86 ,,

Thus even 0·14 per cent of sodium taurocholate under these conditions almost entirely stops amylolytic action. The smaller percentage of glycocholate, however, causes the same increased amylolytic action observed with the smaller percentages of crystallised bile.

With the bile acids the following results were obtained. The glycocholic acid used was a nicely crystallised specimen prepared from ox bile, while the taurocholic acid, prepared from the same source, was amorphous:—

Per cent bile acid.	Weight Cu in one-fourth.	Total amount sugar.	Starch converted.
0	0·0694 grm.	0·1420 grm.	25·56 per cent
0·01 taurocholic	0·0753 ,,	0·1538 ,,	27·68 ,,
0·05 ,,	0·0783 ,,	0·1598 ,,	28·76 ,,
0·10 ,,	0·0060 ,,	0·0146 ,,	2·63 ,,
0·20 ,,	0 ,,		
0·05 glycocholic	0·0523 ,,	0·1082 ,,	19·47 ,,
0·10 ,,	0·0095 ,,	0·0234 ,,	4·21 ,,
0·20 ,,	0·0056 ,,	0·0136 ,,	2·44 ,,
0·50 ,,	trace		
1·00 ,,	0		

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* *Monatshefte für Chemie*, 4, 89.

† *Zeitschrift für analatische Chemie*, 22, 448.

It is thus seen that 0·1 per cent taurocholic acid prevents amylolytic action almost entirely, while 0·2 per cent does not allow the conversion of any starch into sugar. This agrees exactly with the results obtained by Maly and Emich.[*] These same investigators, however, found only a trace of amylolytic action in the presence of 0·05 per cent taurocholic acid, a result which does not agree with what we have found working, however, under somewhat different conditions.

The presence of 1·0 per cent glycocholic acid entirely prevents the conversion of starch into sugar, while 0·5 per cent allows only the smallest amount of diastatic activity. Maly and Emich likewise found that 1·0 per cent glycocholic acid stopped the diastatic action of a saliva.

We have repeated the last series of experiments in part, using, however, normally alkaline saliva instead of neutralised.

Per cent bile acid.	Weight Cu in one-fourth.	Total amount sugar.	Starch converted.
0	0·0590 grm.	0·1212 grm.	21·81 per cent.
0·1 glycocholic	0·0107 ,,	0·0258 ,,	4·64 ,,
0·2 ,,	0·0057 ,,	0 0139 ,,	2·50 ,,
0·1 taurocholic	0·0052 ,,	0 0126 ,,	2·26 ,,

These results agree exactly with the preceding, and both together plainly show that only small percentages of bile acids are required to entirely prevent the amylolytic action of saliva. Assuming that the amylolytic ferment of the pancreatic juice is similar in its nature to the ferment of saliva, it would follow from our experiments that whether the contents of the intestines are acid or alkaline, the presence, beyond a certain percentage of taurocholic acid, either as free acid or as a taurocholate, would tend to diminish amylolytic action. Very small percentages, however, would have little, if any, retarding effect, indeed might even increase amylolytic action. As to glycocholic acid, the free acid is much more powerful in its action on the amylolytic ferment than the sodium salt of the acid.

Considering these results in the light of a possible application to changes in the intestinal canal, it becomes an interesting point to ascertain whether bile itself exerts the same influence on amylolytic action as the bile salts. Moriggia and Battistini[†] state that while bile mixed with chyme gives a precipitate which, among other things, contains mucin, bile acids, and pepsin, thus hindering gastric digestion, it does not, on being mixed with saliva, hinder its amylolytic action. This they found to be the case both with bile containing mucin and with bile from which the mucin had been removed by acidifying. We have, therefore, made the following experiments with fresh ox bile containing 7·46 per cent of solid matter. The digestive mixtures contained as before 1 per cent of starch, 2 per cent of neutral saliva, and were warmed at 40° C. for 30 minutes:—

Ox bile.		Weight Cu in one-eighth.	Total amount sugar.	Starch converted.
0	per cent.	0·0753 grm.	0·3072 grm.	27·64 per cent.
2·0	,,	0·0875 ,,	0·3568 ,,	32·11 ,,
5·0	"	0·0690 ,,	0·2824 ,,	25·41 ,,
10·0	,,	0·0719 ,,	0·2944 ,,	26·50 ,,
20·0	,,	0·0770 ,,	0·3144 ,,	28·30 ,,

Here, in close accord with what has been found before, the presence of a small percentage of bile causes increased amylolytic action; larger percentages, however, have little, if any, effect; certainly not such an effect as would be expected from the known action of the bile salts. The bile itself possessed to a slight extent diastatic action; 20 c.c. of the bile (20 per cent) converting 4·53 per cent starch into sugar in 30 minutes. This, however, could hardly account for the increased amylolytic action noticed above in the presence of 2 per cent of bile. Wittich[‡] and also Hofmann have noticed the occasional diastatic action of bile, Wittich even extracting the ferment from human bile by his glycerine method. Gianuzzi and Bufalini[*] have shown that the action varies considerably in bile from different animals and individuals, and without any apparent dependence upon the nature of the food. Ewald[†] states that the diastatic capacity of bile appears to be slight in all cases, and is not found in bile which has stood for some time. We have found, however, in bile from several animals considerable diastatic power; thus in one sample of fresh sheep's bile, 25 c.c. (25 per cent) converted 24·33 per cent of starch into sugar in 30 minutes at 40° C. We have likewise found great variation in diastatic power, varying, expressed in the percentage of starch converted into sugar under the conditions described, from 4 to 24 in the case of herbivorous animals. We have also noticed in bile from sheep and oxen the presence of a small amount of sugar, or at least a substance capable of reducing Fehling's solution. In one instance the amount was not inconsiderable; 25 grms. of ox bile yielding by Allihn's method, 0·040 grm. metallic copper, equal to 0·0209 grm. dextrose or 0·08 per cent. Naunyn, we believe, has already claimed the presence of sugar in bile.

While we know then that the bile acids and bile salts by themselves retard very decidedly the amylolytic action of ptyalin, it would appear that the retarding influence of the latter may be, in part at least, counteracted by other substances naturally present in the bile.

(To be continued).

A CATALOGUE OF CHEMICAL PERIODICALS.[‡]

By H. CARRINGTON BOLTON, Ph.D.,

Professor of Chemistry in Trinity College, Hartford, Conn.

(Continued from p. 247).

Explanation of Signs.

+ Following a date signifies current at the date in question.
|| Following a date signifies publication discontinued.

Brandes, Rudolph.
See Annalen der Pharmacie.

Brewster's Journal of Science.
See Edinburgh Journal of Science *and cf.* Philosophical Magazine.

Brugnatelli, L.
See Annali di chimica; *also*, Giornale di fisica, chimica e storia naturale.

Bucholz, Ch. Fr.
See Almanach für Scheidekünstler [*a*]; *also*, Beiträge zur Erweiterung - - - der Chemie; *also*, Taschenbuch für Scheidekünstler.

Buchner's Repertorium.
See Repertorium für die Pharmacie.

Bueletin de la Société chimique de Paris.
Répertoire de chimie pure et appliquée [*a*].

48\. Bulletin de pharmacie [*from* vol. vi.] et des sciences accessoires. Rédigé par Parmentier, C. L. Cadet, L. A. Planche, P. F. G. Boullay, J. P. Boudet, et P. R. Destouches, 6 vols., 8vo. Paris, 1809-'14.

Continued under the title:

[a] Journal de pharmacie et des sciences accessoires. Rédigé par C. L. Cadet, L. A. Planche, P. F. G. Boullay, J. P. Boudet, J. J. Virey, J. Pelletier et a Vogel. Deuxième série. 27 vols. (i.-xxvii.), 8vo. Paris, 1815-'41.

Continued under the title:

[b] Journal de pharmacie et de chimie contenant une revue de tous les travaux publiés en France, et à l'étranger sur les sciences phy-

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[*] *Loc. cit.*, 118.
[†] *Jahresbericht fur Thierchemie*, 1875, p. 196.
[‡] *Ibid.*, 1872, p. 243.

[*] *Jahersbericht fur Thierchemie*, 1876, p. 197.
[†] "Lectures on Digestion." Amer. ed. p. 77.
[‡] Advance-proofs from the *Annals of the New York Academy of Sciences*.

siques naturelles, médicales et industrielles, ainsi que le bulletin des travaux de la Société de pharmacie de Paris. Troisième série. 46 vols. (I.-XLVI.), 8vo. Paris, 1842-'64.

Continued under the title ;

[c] Journal de pharmacie et de chimie, par Boullay, Bussy, Soubeiran, Henry, F. Boudet, Cap, Boutron-Charlard, Frémy, Guibourd, Barreswil, Buignet, Gobley et Léon Soubeiran. contenant une revue médicale par Le Vigla et une revue des travaux chimiques publiés à l'étranger par J. Nicklès. Correspondants : Durand, Girardin, Morin, Sobrero, C. Calvert, J. Liebig, Taddei, Vogel, Redwood, Malaguti, Persoz, de Vrij, Christison. Quatrième série. 30 vols. (I.-XXX.). 1865-'79.

[d] Cinquième série. 10 vols (I.-X.). Paris, 1880-'84+

Table analytique des auteurs cités et des matières contenus dans les tomes I.-XVI. (1809-'30) du bulletin de pharmacie et des sciences accessoires. 8vo. Paris, 1831.

Table analytique des auteurs cités et des matières contenus dans les tomes XVII-XXVII (1831-'41) du journal de pharmacie et des sciences accessoires. 8vo. Paris, 1842.

49. BULLETIN DES SCIENCES MATHÉMATIQUES ASTRONOMIQUES, PHISIQUES ET CHIMIQUES. Rédigé par Saigey. Première section du bulletin universel des sciences et de l'industrie, publiè sous la direction du Baron de Férussac. 16 vols., 8vo. Paris, 1824-'31.||

(To be continued).

PROCEEDINGS OF SOCIETIES.

CHEMICAL SOCIETY.

Thursday, May 21st, 1885.

Dr. H. MÜLLER, F.R.S., President, in the Chair.

MESSRS. E. G. Amphlett and E. G. Hogg were formally admitted Fellows of the Society.

Certificates were read for the first time in favour of Messrs. Thomas Cradock Hepworth, 32, Cantlowes Road, Camden Square, N.W.; Leonard de Koningh, 40, Methley Street, S.E. ; Charles Langer, 43, Burton Crescent, W.C. ; James Sharp, The Towers, Low Moor, near Bradford ; James Pender Smith, 12, Bromley Road, Lee. S.E.

The following papers were read :—

43. "*A Colorimetric Method for Determining Small Quantities of Iron.*" By ANDREW THOMSON, M.A., B.Sc.

The author has applied the well-known thiocyanate reaction of ferric salts to the quantitative determination of small quantities of iron. The method is almost universally applicable, silver and copper, and in some cases cobalt, being the only common metals that interfere. To perform the analysis, a weighed quantity of substance is dissolved in acid, the excess of acid driven off by evaporation, the iron, if necessary, converted into ferric salt by means of potassium permanganate, and finally the solution is diluted to 1 litre. Into each of two similar cylinders, 5 c.c. of dilute chlorhydric or nitric acid (1 : 5), and 15 c.c. of potassium thiocyanate solution (containing 40 grms. per litre) are poured, and to one a measured bulk of the solution to be tested is added ; both cylinders having been filled up to the same height with distilled water, a standard solution of ferric salt containing 0·0001 grm. Fe per c.c. is added to the other cylinder in quantity sufficient to produce a colour matching that in the cylinder containing the substance under examination.

DISCUSSION.

Dr. PERCY FRANKLAND said that he had been in the habit for several years past of using such a method to determine minute amounts of iron in water.

Prof. CLOWES remarked that it would be important to employ a constant amount of acid, and that the presence of mercuric chloride was especially to be avoided.

44. "*On some Sulphur Compounds of Calcium.*" By V. H. VELEY.

To prepare calcium sulphide in the dry way, pure calcium oxide, hydrated in an atmosphere free from carbonic anhydride, was introduced into a suitable apparatus and heated in a current of hydrogen sulphide at a temperature of 80°, the water eliminated in the course of the change being collected in a drying tube. Starting with known weights of calcium hydroxide, known weights of water and of calcium sulphide retaining a small proportion of water were obtained, and on adding the latter quantity as determined by analysis to the former quantity collected in the drying tube, it was found that the reaction expressed in the equation $Ca(OH)_2+H_2S=CaS+2H_2O$ was practically realised.

It was observed that *dry* calcium oxide is not acted upon by *dry* hydrogen sulphide, and thus another instance is presented of the inability of two substances or elements to directly combine or react without the intervention of a third substance or element.

Anhydrous calcium sulphide is a white powder when freshly prepared, but quickly turns yellow from the formation of oxidised products.

To prepare calcium hydrosulphide in the wet way, known weights of calcium oxide were added to known weights of water saturated with hydrogen sulphide at ordinary temperature, and a current of the gas passed through the liquid until the calcium oxide was dissolved ; the water evaporated by the passage of the gas was collected in a drying tube. The gain in weight of the solution, together with the collected water, less the known weights of calcium oxide, gives the weight of hydrogen sulphide absorbed. The atomic ratio of calcium to sulphide in the resultant solution was determined. It was found that for solutions not containing more than 25 per cent of calcium hydrosulphide (reckoned as anhydrous) the reaction which took place is represented by the equation—

$$CaO+2H_2S=Ca(SH)_2+H_2O.$$

Calcium sulphocarbonate was prepared by passing hydrogen saturated with the vapour of carbon disulphide into water in which calcium sulphide was suspended. A red solution was produced, the properties of which accorded with those noticed by Berzelius, From this a red crystalline material separated on evaporation, approximately represented by the formula $Ca(OH)_2CaCS_3,7OH_2$.

Dry calcium sulphide does not absorb carbon disulphide, and it is essential to add relatively large quantities of water to ensure the absorption. When a solution of calcium hydrosulphide is submitted to a current of hydrogen saturated with the vapour of carbon disulphide, hydrogen sulphide is at first given off with precipitation of calcium hydroxyhydrosulphide, HS.Ca.OH ; the absorption of carbon disulphide commences only when the precipitation of this last substance is practically completed. Calcium hydroxyhydrosulphide is presumably the absorbent of carbon disulphide in the material prepared in the gas-works by passing coal-gas contaminated with hydrogen sulphide into slaked lime.

45. "*Spectroscopic Observations on Dissolved Cobaltous Chloride.*" By Dr. W. J. RUSSELL, F.R.S.

The characteristic absorption-spectrum given by cobaltous chloride after dissolution in such media as pure and dry potassium chloride, sodium chloride, calcium chloride, alcohol, glacial acetic acid, and in chlorhydric acid, is seen also in an aqueous solution. Hydrated cobaltous chloride gives an entirely different spectrum. If a somewhat faint indication of the spectrum of the chloride be taken as a standard, it is found possible to determine with tolerable accuracy when the amount of anhydrous chloride in solutions of varying strength and temperature is identical with that in the standard solution. A solution containing 4·18 grms. of cobalt chloride in 10 c.c. of water at 0° C., when observed through a thickness of 7 m.m., forms a convenient standard. If to 10 c.c. of such a solution 2·9 c.c. of water be added, then on raising the temperature to 33°, an amount of anhydrous chloride is re-formed identical with that existing in the standard solution at 0°: this rise of temperature exactly counteracts the effect of adding 2·9 c.c. of water. A series of determinations were made in this manner, and it was found that the number of c.c. of water added to the 10 c.c. of standard being as given in the upper line, the temperature at which the spectrum appeared was as given in the lower line in the table:—

2·1	2·9	4·3	7·4	8·9	10·3	12·1	15·0	16·0
26°	33°	43°	55°	63°	70°	75°	87°	95°

Again, taking the most dilute solution, in which 16 c.c. of water had been added to 10 c.c. of the standard solution, it was found that the same change was effected, *i.e.*, that the chloride spectrum could be developed in it, by the addition to the solution of either 0·864 grm. of hydrogen chloride gas, or 5·26 of sulphuric acid, or 2·47 of calcium chloride; but that the addition of sodium chloride would not develop the bands, although on heating the solution after saturating it with this salt a temperature of 34·5° was sufficient, instead of 95°, to develop the bands.

Zinc chloride was found to act in a different manner. Notwithstanding its power of combining with water, on adding it to the cobalt solution no banded spectrum shows itself, and even when added to a solution in which the spectrum is visible, it causes its disappearance. The explanation is that it must have combined with cobalt chloride, forming a new and stable compound. On evaporating the solution this was found to be the case, and a new salt, a compound of cobalt and zinc, crystallised out. Cobalt bromide, both as a solid and in solution, gives a spectrum very similar to that given by the chloride, but the corresponding bands are nearer the red end of the spectrum. The salt is far more soluble in water than the chloride, and has a stronger affinity for water, as is shown by the much higher temperature required to neutralise the power with which water combines with it. The following determinations similar to those made with the chloride show the increase of temperature necessary to counteract the combining power of given quantities of water with cobalt bromide:—

Standard + Water.	Temp.
10 c.c.	0° C.
10 „ + 3·0	51
10 „ + 4·3	57
10 „ + 7·4	91

DISCUSSION.

Captain **Abney** said experience had taught him that it was necessary to be guarded in drawing conclusions as to changes in molecular composition from observations of spectra; the pitfalls were very numerous. He did not think it safe to conclude that a double salt was not formed because no change in the spectrum was observed when the substance added is itself non-absorbent, as is the case with potassium or sodium chloride.

Mr. **Friswell** had noticed a somewhat similar case when working as Mr. Lockyer's assistant. Whereas an aqueous solution of iodine produces general absorption, a solution in concentrated sulphuric acid or in carbon bisulphide has a spectrum very similar to that of iodine vapour. In the one case there appeared to be some combination; in the other a mere entanglement of the iodine by the solvent.

Captain **Abney** asked if Mr. Friswell had noticed a linear spectrum in the case of the sulphuric acid or bisulphide solution. Mr. Lockyer had told him that it was linear, but he had entirely failed to discover such a spectrum.

Mr. **Friswell** replied that to the best of his recollection it was but a rough approximation to a linear spectrum.

Prof. **McLeod** remarked that Dr. Russell's observations appeared to indicate a sudden change on diluting the solution or altering its temperature; it was scarcely probable, however, that there would be an abrupt passage from the hydrated to the anhydrous condition.

Dr. **Armstrong** inquired if it were not possible that changes might be discovered to have taken place on extending the observations to other regions of the spectrum beyond the ordinarily visible portions?

Mr. **Veley** remarked that the argument was inconclusive which was based on the observation that a double salt was obtained on evaporating the mixed solutions of cobalt and zinc chlorides, and not when sodium or potassium chloride was present instead of zinc chloride, as cases were known in which bodies existing in solution were decomposed as the liquid was evaporated off.

Mr. **Cross** asked if Dr. Russell had made any experiments as to the effect produced by adding colloids.

Dr. **Morley** thought it not impossible that the anhydrous chloride should exist in solution. It was known that a concentrated solution of potassium hydroxide decomposed silver chloride, the reverse change taking place in dilute solution; the former change had been explained on thermo-chemical principles as due to the presence of anhydrous hydroxide.

Mr. **Pickering** said that if anhydrous cobaltous chloride could exist in solution it must be an exception, no similar case being known.

Dr. **Russell**, in reply, said that he had desired to bring forward suggestions rather than definite conclusions. His reason for assuming the existence of the anhydrous chloride in aqueous solution was that it was possible to obtain the same spectrum as when the chloride was dissolved in many different and distinct media; for instance, in fused potassium chloride, in glacial acetic acid, or in anhydrous alcohol. He had been informed by Captain Abney that the "cobalt-tune" was played in the visible spectrum, otherwise he would not venture to lay such stress on his observations. In answer to Professor McLeod's observations, he pointed out that the change *was* gradual, not sudden as he appeared to think.

46. "*The Sulphides of Titanium.*" By Prof. T. E. Thorpe, F.R.S.

No action takes place on passing a mixture of hydrogen sulphide and carbon disulphide vapour, *both carefully dried*, over titanic oxide, TiO_2, at the highest temperature of a Fletcher's tube-furnace; but when no pains are taken to dry the sulphides, the oxide is converted into the hitherto unknown *titanium sesquisulphide*, Ti_2S_3. Thus prepared it is a greenish black powder. The monosulphide, TiS, is obtained on heating this sesquisulphide in dry hydrogen. The complete series of corresponding oxides and sulphides of titanium is therefore now known.

47. "*Note on the Formation of Titanous Chloride.*" By Prof. T. E. Thorpe, F.R.S.

If a quantity of mercury and titanium tetrachloride are sealed up in a tube together and briskly shaken, so as to throw the mercury into extremely fine globules, it will be noticed after a short time that a violet crystalline powder is gradually formed, and after some days the contents of the tube appear to be no longer liquid. The tetrachloride is, in fact, gradually converted, even at the ordinary temperature of the air, into the violet titanous chloride by the action of the finely-divided mercury, with the simultaneous formation of calomel. The conversion is more rapidly accomplished by placing the tube in a water-bath; at a temperature of about 98° the contents of the tube seem to become solid in about half an hour. If the temperature of the tube be now raised to about 200° to 250° the reverse change occurs; titanium tetrachloride and metallic mercury are re-formed.

This alternate formation of the solid violet trichloride and the colourless liquid tetrachloride in contact with mercury or calomel may be repeated an indefinite number of times, and constitues an interesting example of the mode in which the direction of a chemical change is modified by temperature.

Friedel and Guérin (*Ann. Chim. Phys.* [5], vii., 24) obtained the violet chloride by the action of molecular silver on the tetrachloride, but in this case a temperature of 200° is required to bring about the change. At a still higher temperature the reverse action occurs, as in the case with mercury.

Research Fund.

A meeting of the Research Fund Committee will be held in June. Fellows desiring grants are requested to make application before June 11th.

At the next meeting, on June 4th, the following paper will be read:—

"On the Constitution of the Haloid Derivatives of Naphthalene." By Prof. Meldola.

PHYSICAL SOCIETY.

May 23rd, 1885.

Prof. Guthrie, President, in the Chair.

Dr. A. H. Fison was elected a member of the society.

The following communications were read:—

"*Experiments showing the Variations caused by Magnetisation in the Length of Iron, Steel, and Nickel Rods*," by Mr. Sheeford Bidwell.

The subject of the extension and retraction of bars of iron and nickel under the action of magnetic force has been investigated by Dr. Joule and A. M. Meyer and by Mr. Barrett. In the present experiments the magnetising force has been increased, with the result of bringing out some striking and novel characteristics. The apparatus employed consisted of a vertical magnetising helix considerably longer than the experimental rod, the latter forming the central portion of a compound rod, the two ends being of brass. The lower end of this rod is plane and stands on a firm support, the upper end is a knife-edge which bears against a brass lever, 18 c.m. in length, about 1 c.m. from the fulcrum; the portion of the rod to be examined is in the central portion of the helix. The above lever is furnished with another knife-edge at the end, which acts in a similar manner on a second lever, at the extremity of which is a small mirror. A lamp and vertical scale being placed at a distance of 470 c.m. the slightest motion of the mirror could be read with great accuracy, an elongation of the bar amounting to 1-100,000th m.m. being easily detected. A few of the more important results are as follow:—In the case of soft iron the bar continually increased in length till nearly saturated, up to which point Dr. Joule had traced it, but then it reached a maximum, decreased, and continued decreasing to the limit of the experiments, at which point the retraction was about double of what the extension had been. The effect depended upon the thickness of the bar, an increase of diameter diminishing the maximum extension and increasing the critical magnetising force, or that force which produced the maximum extension; the results seemed to show that this extension varied inversely as the square root of the diameter of the bar. The general behaviour of steel was the same as that of soft iron, but the critical point varied with the hardness and temper of the metal, appearing to be a minimum for steel of yellow temper. The results of experiments upon nickel coincided with those obtained by Prof. Barrett, the effect of magnetisation being to cause a continuous retraction greater than that obtained with soft iron.

In answer to Prof. Hughes, who believed that the effect of the coil was always to produce *retraction* of the bar, the *extension* at first being due to the molecular arrangement of the particles during magnetisation, Mr. Bidwell further described an experiment showing that the action of the coil was to produce the *extension* of a magnet. Two thin strips of soft iron fastened together at the ends, their central portions being about 2 c.m. apart, were placed in the coil. On making the current the ends were drawn out, the sides coming together.

Prof. Forbes suggested that the effect of thickness was really owing to the irregularity of magnetisation produced by the ends, and that in future experiments the middle of the bar only should be examined.

"*On the Spectral Image produced by a Slowly Rotating Vacuum Tube*," by Mr. Shelford Bidwell.

"*Note on the Action of Light in Diminishing the Resistance of Selenium*," by Mr. Shelford Bidwell.

As the result of their investigation upon the behaviour of selenium, Messrs. Adams and Day arrived at the conclusion that it conducted electrolytically. Since this would necessitate the assumption that selenium is not an element, according to accepted theories, caution must be exercised in accepting this. It seemed possible, however, that since the selenium in the cells had always undergone a prolonged cooking in contact with the metal terminals, selenides of these metals might exist in the selenium, forming a kind of network, and thus affording conduction through the mass, which, without the cooking, is non-conducting. It had not been possible to test this directly, but a somewhat analogous case had been tried. Some precipitated silver had been heated for some hours with sulphur, and the clear liquid poured off. A cell was then made by coiling two silver wires side by side upon a strip of mica, the spaces between the wires being filled with the prepared sulphur, which would contain a small quantity of sulphide of silver. It was found necessary to reduce the resistance of the cell by placing a small strip of silver leaf over the sulphur and cooking again. The cell thus prepared was very sensitive to light; by burning a piece of magnesium near the resistance was reduced to one-third.

Mr. Clark said that Mr. Bidwell's cells probably contained sulphides of copper or silver, substances which the researches of Faraday had shown conducted electrolytically in the solid condition. On the other hand, Cu_2Se and Ag_2Se conducted like metals and were probably often present in the ordinary selenium light cells. Mr. Clark thought that Mr. Bidwell's paper raised this question: What influence had light upon the electrolytic conduction of Cu_2S and Ag_2S and upon the metallic conduction of Cu_2Se and Ag_2Se?

"*On Certain Cases of Electrolytic Decomposition*," by Mr. J. W. Clark.

The first part of this paper consisted of a critical examination of the behaviour of those substances which have been described as exceptions to Faraday's laws, with the object of generalising as to the condition of internal or molecular structure corresponding to their electrical properties. The second part described an experimental investigation into the nature of the conduction of fused mercuric iodide and mercuric chloride, both of which were stated to undergo electrolytic conduction. Decomposition and re-combination of the products of electrolytic action may, however, follow so closely as to simulate metallic conduction. The first product of electrolytic decomposition of mercuric iodide was stated to be iodine and mercuroso-mercuric-iodide (Hg_4I_6), which latter, under the continued action of the current, yields free mercury. Similarly it was found that fused mercuric chloride, when electrolysed between graphite terminals, split up into chlorine and mercurous chloride. Metallic conduction, *i.e.*, conduction without decomposition in fused compound solids, therefore appears to be unknown.

"*Note on Electrical Symbols*," by Mr. J. Munro.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

Note.—All degrees of temperature are Centigrade unless otherwise expressed.

Comptes Rendus Hebdomadaires des Séances, de l'Académie des Sciences. Vol. c., No. 19, May 11, 1885.

On Spontaneously Reversible Spectral Rays, and on the Analogy of the Laws of Distribution and Intensity with those of the Rays of Hydrogen.—A. Cornu.—If we examine the luminous spectra of incandescent vapours, we often distinguish groups of rays which are repeated with a more or less regular periodicity; these repetitions are still more striking if we extend the field of observation to the extreme limit of the ultra-violet spectrum. The analogy of these periodic groups with the harmonics of sonorous bodies presents itself at once to the mind. Unfortunately, the simplicity of these relations vanishes if we substitute for the contemplation of spectral images the precise numerical determination of the wave-lengths. The true aspect of the problem is to find if there are not in all spectra certain groups of rays having characters in common, independent of the chemical nature of the incandescent vapour. There exists a class of rays having characters so distinct that they cannot be confounded with others. These are the spontaneously reversible rays described by the author in 1871 (*Comptes Rendus*, lxxiii., p. 332), found in most of the spectra of metallic vapours. He comes to the conclusion that, in the metallic spectra certain series of spontaneously reversible rays present the same laws of distribution and of intensity as the rays of hydrogen.

The Electric Conductivity of Solid Mercury and of Pure Metals at Low Temperatures.—MM. Cailletet and Bouty.—The coefficient of variation in the conductivity of solidified mercury is more than five times greater than that of liquid mercury, and differs little from that of other pure metals in the solid state.

Action of Aluminium on Aluminum Chloride.—M. Friedel and L. Roux.—When aluminium chloride in vapour is passed over metallic aluminium in a glass tube traversed by a current of pure, dry hydrogen there is produced a reaction below the melting-point of aluminium; crystals of colourless aluminium chloride are deposited in the cold parts of the tube, and near the metal is deposited a brownish grey-matter containing aluminium, silicon, and chlorine. This mixture appears to consist, in part, of a subchloride.

Polarisation of Metallic Capillary Tubes by the Efflux of Liquids under High Pressures. — M. Krouchkoll.—If we force a conductive liquid through a capillary metal tube at a pressure lower than 15 atmospheres, the tube and the effluent liquid being placed in connection with the mercury of a capillary electrometer, no polarisation of the tube is observed; but if we increase the pressure the tube begins to be polarised, and this polarisation increases with the pressure.

On a New Battery, the Auto-Accumulator.—M. Jablochkoff.—The author's battery has three electrodes. It includes an oxidisable metal, forming the first electrode; a plate of a slightly oxidisable metal, such as lead, forming the second electrode; and, finally, a third electrode of plates or tubes of very porous carbon in contact with air.

On the Tensions and Critical Points of Certain Vapours.—C. Vincent and J. Chappuis.—The authors give merely the results obtained with hydrochloric acid and methyl chloride. The critical point of hydrochloric acid, according to their researches, lies between 51° and 51·5°. That of methyl chloride is close upon 141·5°.

On Aluminium Oxychlorides. — MM. Hautefeuille and Perrey.—The authors obtain a series of aluminium oxychlorides by heating an ingot of aluminium to incipient redness in a current of pure oxygen, and then introducing along with the oxygen vapours of aluminium chloride. The product does not consist of a single oxychloride, but of a mixture of oxychlorides formed in the different phases of the combustion. These oxychlorides are the richer in oxygen the higher the temperatures at which they have been produced. The products analysed contain to 1 atom of chlorine 2·6, 3·5, 4·1, 4·5, 5, 7, 7·5 atoms of oxygen. The easy and complete solubility of the products poorest in chlorine in very dilute acids and alkalies shows that they do not contain free alumina. These compounds are white, of a crystalline structure, and they act upon polarised light with an energy which increases rapidly with the proportion of oxygen present. At full redness they lose all their chlorine. They are split up by water.

The Apparent Volatilisation of Silicon at 440°.—MM. Hautefeuille and Perrey.—According to the authors it would seem that silicon, though fixed at 1300°, is volatile at 440°.

Preparation of Arsenic Acid, and the Existence of Compounds of Arsenious and Arsenic Acids.—A. Joly.—On treating arsenious acid with "ordinary" nitric acid there is little action in the cold, but on heating the attack begins, and the mass soon solidifies. On expelling the excess of nitric acid by heat, and taking up in boiling water, there are obtained on cooling first octahedral crystals of arsenious acid, and then, on a second concentration, circular crystals of the compound—

$$2AsO_5,3AsO_3,Aq.$$

If a very large proportion of arsenious acid escapes oxidation, there are formed bulky rectangular crystals of $AsO_5 2AsO_2 Aq$. In presence of a great excess ef arsenic acid the syrupy liquid deposits very fine acicular crystals of AsO_5,AsO_3Aq.

MISCELLANEOUS.

Royal Institution.—Professor Dewar, F.R.S., will give a discourse on "Liquid Air and the Zero of Absolute Temperature" at the Royal Institution, at the last evening meeting of the season on Friday, June 5.

The late Mr. Peter Squire.—On Wednesday, May 20, the ceremony of unveiling a portrait medallion of the late Mr. Peter Squire in the Pharmaceutical Society's house in Bloomsbury Square was performed by Sir Spencer Wells, Bart., in the presence of a large gathering. The company included Sir Oscar Clayton, Dr. Morell Mackenzie, Mrs. Rose Mary Crawshay, Dr. Protheroe Smith, Dr. J. W. Ogle, Dr. Hare, and the Rev. W. Barker.—The president of the society (Mr. Carteighe), in opening the proceedings, read letters from Sir Henry Acland (President of the General Medical Council), Sir John Clark, Bart., Sir Edwin Saunders, Dr. Quain, F.R.S., Dr. Charles West, Dr. Buchanan, F.R.S., Mr. White Cooper, F.R.C.S., and others, regretting their inability to be present, and expressing sympathy with the object of the meeting.—Sir Spencer Wells, unveiling the medallion, spoke of the feeling which a very great many members of the medical profession had for Mr. Squire, and how much they felt the association of the work of the pharmaceutical chemist with their own. He then referred to the ability, energy, and industry with which Mr. Squire worked in arranging our present Pharmacopœia, and in bringing together the Scotch, Irish, and English Pharmacopœias so as to form one British work. He mentioned how Mr. Squire's success as a practical pharmacist had gained for him the appointment which he held for 40 years of chemist to the Queen, and stated that when anæsthesia was first attempted in this country Mr. Squire constructed the apparatus by which the first operation was performed, which apparatus is now in the museum of University College.

He also stated that Mr. Squire was three times president of the Pharmaceutical Society, and was its examiner in botany for 27 years. He concluded by expressing his admiration for the ability and industry which Mr. Squire evinced throughout his long life.—Dr. Garrod, F.R.S., Mr. Haynes Walton, F.R.C.S., Dr. Theodore Williams, and Professor Bentley having also spoken, the proceedings terminated.

MEETINGS FOR THE WEEK

MONDAY, 1st.—Royal Institution, 5. General Monthly Meeting.
—— Society of Chemical Industry, 8. "The Influence of Phosphates upon Fermenting Worts," by A. G. Salamon and W. de Vere Mathew.
TUESDAY, 2nd.—Royal Institution, 3. "Digestion and Nutrition," by Prof. Gamgee.
THURSDAY, 4th.—Royal Institution, 3. "Poisons," by Prof. C. Meymott Tidy.
—— Royal, 4.30.
—— Chemical, 8. Ballot for the Election of Fellows. "Constitution of the Haloid Naphthaline Derivatives," Prof. Meldola.
FRIDAY, 5th.—Royal Institution, 8. "Liquid Air," Prof. Dewar, at 9.
—— Geologists' Association, 8.
SATURDAY, 6th.—Royal Institution, 3. "The Teaching of the Twelve Apostles"—an Ancient Document—with Illustrations from the Talmud, by the Rev. C. Taylor.

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REMARKS ON THE CONSTRUCTION OF CHEMICAL EQUATIONS.

By H. G. MADAN, M.A., F.C.S.

IT seems a matter of regret that in most, if not all, of our text-books on chemistry the principles of the method of expressing chemical changes by the arrangement of symbols called (from algebraic analogies) an "equation," are either omitted altogether or very imperfectly and cursorily explained. In the more advanced text-books such elementary knowledge appears to be assumed, while in the elementary treatises it is not given. After a description of some experiment or reaction, the student is generally abruptly told that "the change may be represented by the following equation"; and then follows the cut-and-dried line of formulæ, with little or no explanation as to what the signs connecting the formulæ really mean, and why certain "coefficients," and not larger or smaller ones, are prefixed to the formulæ.

I do not attach an excessive value to symbolic representations of chemical changes, nor do I think it right to plunge a beginner into a maze of formulæ before he has made such progress in practical work as to feel the want of some short and significant method of expressing the results of his experiments, and to be able to appreciate rightly and fully the grounds on which certain symbols having exact reference to weight and volume have been chosen to represent the substances he has dealt with. I should rather consider that the atomic theory is best introduced after the student has become familiar with the series of nitrogen oxides, and with ethylene and methane, the consideration of which led Dalton to propose the theory, and to invent the system of symbols for the direct purpose of expressing his chemical atoms. Such series, together with the elements hydrogen, oxygen, and nitrogen, which would have been previously studied, afford valuable illustrations of Avogadro's law, and lead up to the conception of molecules as distinguished from atoms, the development of which will probably render the chemistry of the future little more than a branch of physics.

I do not, however, intend here to sketch out a course of chemical work, but simply to urge the desirability of fuller and more exact explanations of the system of symbols and equations than are usually given. In furtherance of this object I should like to submit the following observations, apologising at the same time for their elementary character.

1. A chemical change consists in a molecular action of such a kind as to cause a re-arrangement of the atoms of the substances which take part in it, with formation of new molecules differing in properties from the original ones.

2. In the quantities of substances taken for practical experiments many millions of molecules must take part in the change; but we can express the result quite accurately by stating what occurs in the case of the *smallest* number of molecules that can take part in the action at all. Thus, when we mix 1 c.c. of oxygen gas with 2 c.c. of hydrogen gas and cause combination to take place, it is sufficient to consider the action that occurs between one molecule of oxygen and two molecules of hydrogen, there being sufficient grounds for believing that the same action is going on between every other molecule of oxygen and pair of molecules of hydrogen in the whole mass of the mixed gases.

3. In expressing a chemical change by symbols, then, we proceed in the following way:—

Given—

1st. The qualitative results of the action, *i.e.*, a knowledge of all the substances which take part in it and are produced by it.

2nd. The fact that no weight is lost or gained in the action.

3rd. The correct formulæ of the molecules of all the substances concerned in it.

We place the formulæ of the original molecules as the factors on the left-hand side of an equation, and the formulæ of the new molecules on the right-hand side; and we choose as coefficients for these factors the *smallest* whole numbers which will satisfy the equation. These coefficients, although often obtainable by mere inspection and common sense, and generally in text-books put thus before learners in a rather haphazard way, can be best determined by the usual algebraic methods for solving simultaneous equations.

Thus we may put $a, b, c \ldots.$ for the coefficients on one side of the equation, and $p, q, r \ldots.$ for those on the other side, and adopt their minimum integral values (since *less* than one molecule cannot be dealt with) in constructing the complete equation for expressing the chemical change.

The following may serve as a simple example:—In the action of copper on hydrogen nitrate it is known that under definite conditions nothing but copper nitrate, nitrogen dioxide, and water are produced. Hence we have—

$$a\mathrm{HNO_3} + b\mathrm{Cu} = p\mathrm{CuN_2O_6} + q\mathrm{N_2O_2} + r\mathrm{H_2O}.$$

Now if we consider how the atoms to which a refers are distributed in the new molecules expressed by the formulæ on the right-hand side of the equation, we find—

With regard to the hydrogen atom, $a = 2r$ (i.)
,, ,, nitrogen atom, $a = 2p + 2q$ (ii.)
,, ,, oxygen atom, $3a = 6p - 2q + r$ (iii.)
,, ,, copper atom, $b = p$.

Eliminating q and r,

$$\text{From (i.)},\ r = \frac{a}{2}$$

$$\text{From (ii.)},\ q = \frac{a - 2p}{2}$$

Substituting these values in (iii.)—

$$3a = 6p + 2\frac{a - 2p}{2} + \frac{a}{2}$$

$$\begin{aligned} 6a &= 12p + 2(a - 2p) + a. \\ &= (12 + 4)p + 3a \end{aligned}$$

Hence $(6 - 3)a = 8p, \ \therefore \ 3a = 8p,$
and $p = \tfrac{3}{8}a.$

Again, from (ii.),—

$$2q = a - 2(\tfrac{3}{8}a) = 1 - \tfrac{6}{8}a = \tfrac{1}{4}a.$$

$$\therefore \ q = \tfrac{1}{8}a.$$

And from (i.), $r = \tfrac{1}{2}a.$

Hence, taking $a = 8$, a minimum integral value,
$b = 3$
$p = 3$
$q = 1$
$r = 4$

Substituting these values in the chemical equation, we get—

$$8\mathrm{HNO_3} + 3\mathrm{Cu} = 3\mathrm{CuN_2O_6} + \mathrm{N_2O_2} + 4\mathrm{H_2O}.$$

Again, in the preparation of nitrogen dioxide by Pelouze's method, it is known that the only substances required for the reaction are iron protosulphate, potassium nitrate, and hydrogen sulphate; and that the only substances produced are iron persulphate, potassium hydrogen sulphate, nitrogen dioxide, and water.

Hence,—

$$\begin{aligned} &a\mathrm{FeSO_4} + b\mathrm{KNO_3} + c\mathrm{H_2SO_4} = \\ &\quad = p\mathrm{Fe_2(SO_4)_3} + q\mathrm{KHSO_4} + r\mathrm{N_2O_2} + s\mathrm{H_2O}. \end{aligned}$$

Then, with regard to the—

Iron atom, $a = 2p$ (i.)
Sulphur atom, $a + c = 3p + q$ (ii.)
Oxygen atom, $4a + 3b + 4c = 12p + 4q + 2r + s$ (iii.)
Potassium atom, $b = q$ (iv.)
Nitrogen atom, $b = 2r$ (v.)
Hydrogen atom, $2c = q + 2s$ (vi.)

From (i.) we have $p = \frac{1}{2}a$.
,, (iv.) ,, $q = b$.
,, (iv.) and (v.) $2r = b \quad \therefore \quad 2r = q$.
,, (vi.) $\frac{1}{2}q + s = c$.

Substituting these values in (iii.),—

$$4a + 3q + 2q + 4s = 6a + 4q + q + s.$$

Whence, $3s = 2a$, and $s = \frac{2}{3}a$. . . . (vii.)

Substituting these values of c, p, and s in (ii.),

$$a + \frac{1}{2}q + \frac{2}{3}a = \frac{3}{2}a + q.$$

Whence, $\frac{1}{6}a = \frac{1}{2}q$, and $q = \frac{1}{3}a$. . . . (viii.)

Substituting the values of q and s in (vi.),

$2c = \frac{1}{3}a + \frac{4}{3}a$, and $c = \frac{5}{6}a$. . . . (ix.)

Thus we have—

From (iv.) and (viii.), $b = \frac{1}{3}a$.
,, (ix.) $c = \frac{5}{6}a$.
,, (i.) $p = \frac{1}{2}a$.
,, (viii.) $q = \frac{1}{3}a$.
,, (iv.) and (v.) $r = \frac{1}{6}a$.
,, (vii.) $s = \frac{2}{3}a$.

Whence, taking $a = 6$, a minimum integral value,—

$b = 2 \qquad q = 2$
$c = 5 \qquad r = 1$
$p = 3 \qquad s = 4$

Substituting these values in the chemical equation, we get,—

$$6FeSO_4 + 2KNO_3 + 5H_2SO_4 = \\ = 3Fe_2(SO_4)_3 + 2KHSO_4 + N_2O_2 + 4H_2O.$$

Possibly such calculations (although extremely easy) will not in all cases take a shorter time than the haphazard common-sense method usually adopted; but I think that it is at any rate worth while to draw attention to the real principles involved in the construction of chemical equations.

INFLUENCE OF BILE, BILE SALTS, AND BILE ACIDS ON AMYLOLYTIC AND PROTEOLYTIC ACTION.*

By R. H. CHITTENDEN and GEO. W. CUMMINS.

(Continued from p. 258).

2. *Influence on the Proteolytic Action of Pepsin.*

It has long been known that bile has a retarding action on pepsin digestion, and Maly and Emich have recently shown the percentages of bile acids necessary to bring the action of pepsin to a standstill. We have, however, in addition, experimented with bile itself, and as in the case of the amylolytic ferment, have endeavoured to study the influence of the bile acids quantitatively. The method employed for measuring proteolytic action is one frequently used in this laboratory, and which has invariably given satisfactory results. The only feature which calls for description is the preparation of the proteid matter to be digested. The material consists of carefully selected and thoroughly washed blood fibrin. All soluble matters are removed by successive extraction with boiling water, cold and boiling alcohol, and finally with cold and warm ether. The fibrin is thus obtained in a perfectly friable condition and can easily be ground to a coarse powder. It is then dried at 100° to 110° C. This material is well adapted for quantitative experiments with pepsin-hydrochloric acid; the residue remaining after a digestion can be rapidly filtered with the aid of a pump, and can be easily freed, by washing, from peptones and other soluble products of digestion.

The gastric juice employed in the experiments consisted of a hydrochloric acid solution of a glycerine extract of pig's stomach, in the proportion of 10 grms. glycerine extract to one litre of 0·2 per cent hydrochloric acid. 50 or 100 c.c. of this pepsin-hydrochloric acid were employed in each experiment, to which was added 1 or 2 grms. of the dried fibrin (1 per cent), together with the given percentage of bile or bile acids.

We first tried the influence of bile itself, using fresh ox bile, slightly alkaline in reaction and containing 10·02 per cent of solid matter.

The digestive mixtures were warmed at 40° C. for two hours, then filtered at once and the undigested residue washed thoroughly,* and then dried at 100° C., until of constant weight. Following are the results of the first series of experiments, with 2 grms. of fibrin and 100 c.c. of gastric juice:—

Bile in digestive mixture.	Weight of undigested residue.	Fibrin digested.
0 per cent.	0·1957 grm.	90·21 per cent.
0·25 ,,	0·1890 ,,	90·55 ,,
0·50 ,,	0·2050 ,,	89·75 ,,
1·00 ,,	0·2234 ,,	88·83 ,,
3·00 ,,	0·5453 ,,	72·73 ,,
5·00 ,,	0·7642 ,,	61·84 ,,

A second series, tried under the same conditions, but with larger percentages of bile, gave the following results:—

Bile in digestive mixture.	Weight of undigested residue.	Fibrin digested.
0 per cent.	0·1979 grm.	90·10 per cent.
0·25 ,,	0·2456 ,,	87·72 ,,
0·50 ,,	0·1927 ,,	90·36 ,,
9·00 ,,	1·1955 ,,	40·22 ,,
13·00 ,,	1·6611 ,,	16·94 ,,
16·50 ,,	1·7812 ,,	10·94 ,,
20·00 ,,	1·9241 ,,	3·29 ,,

From these two series of experiments it is evident that the presence of bile, from 1 per cent upward, causes diminished proteolytic action, the retarding effect being proportionate to the amount of bile present. 20 per cent of bile stops the action under these conditions almost completely. It is fair to presume, therefore, that the reflux of but a small amount of bile into the stomach would be productive of a diminished proteolytic action.

These results therefore agree with the older statements of Brücke, Hammarsten, and others, to the effect that bile added to a gastric digestion has the effect of bringing the proteolytic action to a standstill.

We next tried the influence of the individual bile acids with the following results:—

Taurocholic acid.	Weight of undigested residue.	Fibrin digested.
0 per cent.	0·1311 grm.	86·89 per cent.
0·025 ,,	0·1461 ,,	85·39 ,,
0·050 ,,	0·2200 ,,	78·00 ,,
0·100 ,,	0·2421 ,,	75·79 ,,
0·200 ,,	0·2668 ,,	73·32 ,,
0·500 ,,	0·3579 ,,	64·21 ,,

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* Reprinted from *American Chemical Journal*, vol. vii., No. 1.

* In all of the pepsin hydrochloric acid digestions the presence of bile or bile salts naturally causes more or less of a precipitate, dependent in amount upon the percentage of bile and also upon the amount of digestive products. In washing the undigested fibrin it was of course necessary to remove this precipitate. This was accomplished by pouring over the precipitate on the filter 50 c.c. of 0·5 per cent potassium hydroxide and then washing with water until the alkali was wholly removed. The following experiment shows that under these conditions the alkali affects the swollen fibrin but little, if any. Two portions of fibrin of 2 grms. each were warmed with 100 c.c. of 0·2 per cent HCl for thirty minutes, then filtered and one washed with water alone, the other with water and alkali. The first gave 1·9272 grms. dried residue, the other 1·9155 grms.

Here it is seen that the smallest percentage of taurocholic acid added produces a distinct effect on proteolytic action, and in the next series of experiments still smaller percentages of acid caused an equally marked effect. In both series of experiments the mixtures were warmed at 40° C. for one hour and thirty minutes.

Taurocholic acid.	Weight of undigested residue.	Fibrin digested.
0 per cent.	0·1499 grm.	85·01 per cent.
0·010 ,,	0·1819 ,,	81·81 ,,
0·015 ,,	0·1900 ,,	81·00 ,,
0·020 ,,	0·2947 ,,	70·53 ,,
0·050 ,,	0·3110 ,,	68·90 ,,

Adding the taurocholic acid to the digestive mixture in the form of a sodium salt has the effect of diminishing still further the action of the ferment; doubtless a larger percentage of the acid remains in solution in this case.

Taurocholic acid.	Weight of undigested residue.	Fibrin digested.
0 per cent.	0·2059 grm.	79·41 per cent.
0·1 ,,	0·6198 ,,	38·02 ,,
0·2 ,,	0·6426 ,,	35·74 ,,
0·5 ,,	0·6475 ,,	35·25 ,,

Maly and Emich found that 0·2 per cent taurocholic acid entirely stopped the action of pepsin; in our experiments, however, ferment action was still manifest, even in the presence of 0·5 per cent acid. Whether this difference in result is due to difference in the acid used, or to difference in method, we cannot say. Glycocholic acid we found to be entirely without influence on the action of pepsin, as did also Maly and Emich.

(To be continued).

A CATALOGUE OF CHEMICAL PERIODICALS.*

By H. CARRINGTON BOLTON, Ph.D.,
Professor of Chemistry in Trinity College, Hartford, Conn.

(Continued from p. 259).

Explanation of Signs.

\+ Following a date signifies current at the date in question.
‖ Following a date signifies publication discontinued.

50. Časopis chemiků Českých. Redaktor: Karel Otakar Čech. Roy. 8vo. v Praze, 1869.

Continued under the title:

[a] Časopis Chemiků českých. Spolu organ spolku cukro-várníků východních Čech. Redaktor: Karel Otakar Čech Hlavní spolupracovník: Frant. Štolba. Roy. 8vo. v Praze, 1870,'71.

Continued under the title:

[b] Zpravy spolku chemiků českých. Rediguje V. Šafařík. 2 vols., 8vo. v Praze, 1872-'76.

Cattaneo, Antonio.
See Giornale di farmacia, chimica e scienze accessorie.

Čech, Karel Otakar.
See Časopis chemiků českých.

51. Centralblatt für Agricultur-Chemie und rationellen Wirthschaftsbetrieb. Referirendes Organ für naturwissenschaftliche Forschungen in ihrer Anwendung auf die Landwirthschaft. Herausgegeben von R. Biedermann. [*Edited in* 1875 *by* W. Detmer; *in* 1876-'79 *by* R. Biedermann, unter Mitwirkung von Mor. Fleischer und Bernh. Tollens.] 18 vols., 8vo. Leipzig, 1872-'80.

Continued under the title:

[a] Beidermann's Centralblatt für Agriculturchemie und rationellen Landwirthschafts-Betrieb. Referirendes Organ für naturwissenschaftliche Forschungen in ihrer Anwendung auf die Landwirthschaft. Fortgesetzt unter der Redaction von M. Fleischer und unter Mitwirkung von W. Borgmann, O. Kellner, A. König, [*and others*]. 4 vols., 8vo. Leipzig, 1881-'84+

Chandler, C. F.
See American Chemist.

52. Chemical (The) Gazette; or, Journal of Practical Chemistry in all its applications to Pharmacy, Arts, and Manufactures. Conducted by William Francis and Henry Croft. 17 vols., 8vo. London, 1843-'59.

Followed by:

[a] Chemical (The) News [*from* vol. iii., and Journal of Physical Science], with which is incorporated the "Chemical Gazette." A journal of practical chemistry, in all its application to pharmacy, arts, and manufactures. Edited by William Crookes. 50 vols.. sm. 4to. London, 1860-'85.+

53. Chemical News (The) and Journal of Physical Science, with which is incorporated the "Chemical Gazette. A journal of practical chemistry in all its applications to pharmacy, arts, and manufactures. Edited by William Crookes. *Authorised American reprint.* 6 vols., 4to. New York, 1867-'70.‖

Followed by the American Chemist, *q. v.*

Chemical Record.
See Pharmacist and Chemical Record.

(To be continued).

A DELICATE TEST FOR ANTIMONY.

By Prof. OSCAR C. S. CARTER,
Central High School, Philadelphia.

When a few drops of a solution of antimony, acidulated with hydrochloric acid but free from nitric acid, are introduced into a porcelain dish containing a piece of zinc and a strip of platinum foil in contact, there is formed at once in concentrated solutions, and slowly in dilute solutions, a precipitate of metallic antimony, which adheres firmly to the platinum, and is of a black or brown colour according to the thickness of the deposit. This coating of antimony is insoluble in hot or cold hydrochloric acid, but readily soluble in nitric acid. When much zinc and hydrochloric acid are used a portion of the antimony escapes as antimoniuretted hydrogen, but very little antimony escapes if very dilute acid and a small piece of zinc be used. Rieckher found (*Jahresb.*, 1867, p. 255) that when antimonious solutions are decomposed by zinc and dilute acids, the quantity of metallic antimony precipitated is to that evolved in the form of stibine as from 95 : 8 to 96 : 4, so that only a small fraction passes off as stibine.

Having frequently noticed that the test would respond when the most minute quantities of tartar emetic were used, I have made the following experiments with a view of ascertaining the delicacy of this test in solutions of tartar emetic.

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* Advance-proofs from the *Annals of the New York Academy of Sciences.*

One grm. of tartar emetic was dissolved in hydrochloric acid and water; sufficient acid was used to dissolve the basic oxychloride formed, and the whole was diluted to 2 litres with water. Then 1 c.c. contained 0·0005 of a grm. of tartar emetic, or 0·0001807 of a grm. of antimony, since tartar emetic contains 36·14 per cent of antimony. 1 c.c. of the above solution was introduced into a porcelain dish, and a strip of platinum-foil 1 square centimetre in size and a small piece of zinc were used. In a short time the antimony was reduced, and made a black and firmly adherent stain on one side of the platinum. 500 c.c. of the solution were taken from the 2 litres, and diluted to a litre with water and a small quantity of acid. Then 1 c.c. of this last solution would contain 0·00025 of a grm. of tartar emetic, or 0·0000903 of a grm. of antimony. The deposit in this case was not the deep and black one as before, but brownish black, and not so evenly distributed over the platinum. 400 c.c. were now taken from the 2 litres, and diluted as before to a litre. Then 1 c.c. of this solution contained 0·0002 of a grm. of tartar emetic, or 0·0000722 of a grm. of antimony. The deposit of antimony was brown, and in one place black, and only covered a portion of the platinum. 200 c.c. from the first solution were diluted to a litre; 1 c.c. contained 0·0001 of a grm. of tartar emetic, or 0·00003614 of a grm. of antimony. Only a light brown stain was obtained on the platinum, which, however, was very perceptible. 100 c.c. from the first solution were diluted to a litre. Then 1 c.c. of this solution contained 0·00005 of a grm. of tartar emetic, or 0·00001807 of a grm. of antimony. With this dilution no stain whatever was produced on the platinum, even after several trials.

I then procured a platinum wire, and wound around it a thin zinc wire, and introduced it into the solution, which was so dilute that there was scarcely any action on the zinc: 2 drops of hydrochloric acid were added, and when the zinc was dissolved a black stain of antimony was visible on a part of the wire.

In order to secure good results the zinc must remain in contact with the platinum. This is accomplished by taking a piece of zinc in the form of a shot. A flat piece becomes, when covered with hydrogen, light enough to float, and no coating whatever will be deposited.

After finishing the tests I learned that Professor T. G. Wormley had detected smaller quantities of antimony by using drops of a solution of antimony teroxide in hydrochloric acid, but the dilution of my solution was about five times as great as that of the liquid which he employed.

POISONING BY CANNED GOODS.*

By JOHN G. JOHNSON, M.D., of Brooklyn, N.Y.

Having had in my practice six cases of corrosive poisoning from eating canned tomatoes,—finding that none of our works on toxicology gave any information on the dangers of canned goods, and none of the medical works accessible furnished anything to guide the physician on this subject, —after consulting the chemist and former chemist of the Board of Health of Brooklyn, and gaining no information from them, it was thought proper that the matter should be brought before this Society, from which has emanated so many laws beneficial to the community; that by means of the advice obtained from the eminent lawyers, physicians, and chemists composing your body, such knowledge should be secured as will be of service to physicians in the future, should similar cases unfortunately occur in their practice, and necessary legislation be obtained, if that be deemed advisable, to prevent these dangers hereafter. Cases of severe sickness have been reported from time to time in various parts of this country from eating canned food. I know of none of these that have been thoroughly sifted so as to place the matter in reliable form before those competent to judge of a matter so important to the community as its food supply.

While there is no doubt that the preservation of food in hermetically sealed cans has added much to the health and comfort of the public, still it is no less certain that unscrupulous tradesmen have dealt in damaged, unsound, and unwholesome canned food, and that serious sickness has occurred therefrom, both in this country and abroad, till public confidence has been shaken, and a large portion of the community look with doubt and distrust upon all food thus preserved. That this suspicion is not without foundation is shown by the fact that *The Trade*, a newspaper published in the canning interest in Baltimore, gives, in a single issue, the names of fifty-seven firms that deal only in "seconds," or doubtful goods, as a warning to retail grocers not to purchase of them.

To still further aid in elucidating this question, I have, through the kindness of your President, been allowed to invite representative men from the canned goods trade to present their views to you upon this subject, so that this body should have information from their standpoint to aid in the forming of such opinions as may be deemed best upon this important question.

The history of the cases, briefly, is this:—On Thursday, March 6th, 1884, the family of Mr. K. sat down to a lunch consisting of bread and butter and canned tomatoes. The family consisted of Mrs. K., the mother; Theodora, aged 22; Grace, aged 18; John, aged 13; and Osceola, aged 10. A nephew happening to call at that time also sat down to lunch with them. Mr. K. was not home to lunch. The family are strong, hale, and vigorous, with whose constitution and habits I have been acquainted, having attended the family for over twenty years. They all sat down to the table in perfect health. About two hours after the lunch they were all taken with burning pain in the pit of the stomach, intense thirst, dryness of the throat, retching, and tenesmus. These symptoms increasing, at supper-time none were able to be at the table. Mrs. K., thinking that they were suffering from some indigestible food, gave them all a cathartic.

The boys, after some hours, were able to throw off the contents of their stomach, but lay around stupid and cross, and complaining of the pains in their abdomen, while the symptoms in the mother's case and the daughters' continued to increase; and the mother, finding that laxatives and anodynes had no effect, sent for me on the morning of the 10th. At this time Theodora's case had become alarming; there was a severe gastro enteritis; the abdomen intensely tender; the tongue of a fiery red; the tenesmus so severe that the bowel would turn inside out, like the finger of a glove, with the severity of the bearing down in the ineffectual efforts to pass the contents of the bowel. She was beginning to sink into a coma, aroused only by the severity of her pains.

The mother was suffering with the same symptoms, and the daughter Grace had, in addition, an eruption from head to foot, of a fiery red, with intolerable itching, and her skin, which is naturally soft and smooth, was as rough as a nutmeg grater. This stupor passed into a coma so profound that I could not arouse her by any means at hand. Even taking hold of the small hair in front of the upper portion of the ear, and lifting the head from the pillow, would not cause even a quivering of the eyelids. In the evening of Friday, the 14th, she was taken with epileptiform convulsions, so severe and continuous, that I instinctively looked to see if there was a crape on the door each time I drove up to the house. These convulsions continued with increasing severity till Sunday afternoon, when her bowels began to move—when a dark, tarry black fluid substance passed from her at stool. On this being allowed to stand, on the top was seen, floating, a glistening fluid, which showed rainbow colours, like oil on the waters. As the Board of Health had the cases under observation, I directed all evacuations to be kept for their

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* Read before the Medico-Legal Society of New York, April 9th, 1884.

chemist, and this was done, but unfortunately he made no chemical examination.

During all the time that she was in this coma and convulsions she lay in a drenching colliquative sweat, with thin, thready pulse. After the dark tarry movements there were bloody stools, not the small, teasing, straining stools with mucus and blood of dysentery, but hemorrhages, of quite a large amount, mingled with this tarry matter. As the coma passed off, it was found that there was an impairment of nerve power in the left arm, which gradually subsided, with the exception of the muscles controlled by the ulna nerve. There were no marks or bruises on the arm, and no indication of any straining of the joints from the convulsions; and this paralysis of the left arm was attributed to the effects of the poison. A swelling, localised, the size of the fist, in the left iliac fossa, made its appearance, and it was feared that an adhesive peritonitis, with perforation of the intestine and fæcal abscess, would form; but fortunately that has subsided to a large degree, and the probability is that it will cause no further trouble.

As the symptoms of the others were similar, varying only in intensity, I will not detain you with the repetition. During the early part of the sickness she drank largely of milk to quench the intolerable thirst, but that was evidently healthy, as the same milk was served by the same milkman to neighbours, and careful inquiry failed to show that it had disagreed with any.

That they were suffering from some irritant poison was evident from the fact that they all sat down to lunch in perfect health, and all that partook of the lunch were sickened by it. That lunch was bread and butter and canned tomatoes. That it was not caused by the bread and butter was shown from the fact that the husband had eaten of the bread and butter at breakfast and also at supper, and had no trouble. He had not been home to lunch; also a lady who came in to help them had taken of the bread and butter for her tea and had no trouble, while the nephew, who had only taken one meal at the house, and that was this lunch, had suffered severely from the colic, cramps, dizziness, and stupor, and was, after some hours, relieved by vomiting, but his pains continued in the abdomen for several days. This limited the poison to the tomatoes. Could it have resulted from spoiled tomatoes. No! why not? because the sickness resulting from that would have been simply cholera morbus, vomiting, purging, and cramps. That would not produce vertigo, coma, convulsions, and obstinate constipation. Having for many years attended those in the wholesale grocery business, I know something of the method of preparing tomatoes. After the food is placed in the cans and the cap soldered on the goods are processed; that is, put into a steam-bath—the temperature is raised to 240° to 250° F.—and kept there till a pressure of 25 lbs. to the square inch is created in the can. The attendant then thrusts an awl through the hole previously marked in the centre of the cap. The gases blow out of the can. The can is then soldered, while hot. As the can becomes cold the heads bulge in and stay bulged in.

Now, if decomposition begins, the heads of the can bulge out. The gases that form inside of the can distend and force out the heads. In the language of the trade such cans are "swells." It was a well known trick of unscrupulous dealers to go round to the wholesale trade and buy swells,—by heating and punching another hole, or re-processing, as it is termed by canners, the gases would escape and then the heads would assume their concave form again; but cans thus treated would have *two solder holes* instead of one. I examined the can in question; it had only one solder hole. I went through all the cans in the two crates of these tomatoes left in the grocer's, and none had more than one solder hole, and none were swells. Even if the tomatoes had begun to spoil she had them cooked, and cooking would have cured them. Every housewife knows that if her preserves begin to sour, cooking prevents the souring. The reason may not be so generally known. The yeast plant and all ferments are killed by heat. These ferments and all low forms of organisation like bacteria multiply by division. To illustrate: if a chain should break up into separate links, and each separate link grow to make a new chain, and these new chains break up into separate links to again grow and make new chains, this would give you a good idea of the growth of these ferments—so with these ferments, little buds form on the parent stalk, these fall off and grow, and make new stalks for new buds to grow on. Putrefaction and decay, instead of being death, is really giving birth to myriads of little living plants, whose food they furnish. Every decaying apple, or banana, or tomato, every muddy pool in your streets, every damp spot in your houses, is swarming with these tiny scavengers. They dry up and become spores, and are blown around in the air, and if they light on anything capable of furnishing food they multiply with wonderful rapidity. Now, heat kills all these. Why does your housewife keep her milk in a cold place? because cold prevents these ferments from growing. Why does she scald the milk if it threatens to sour? because heat kills these ferments. If she puts the dough in too cold a place it will not rise,—why? because the yeast ferments will not grow. If she puts it into too hot a place it will sour; why? because they multiply so rapidly that they devour all the saccharine matter in the flour, and destructive fermentation has taken place. Now, heat kills all these ferments, and if the tomatoes had commenced to decay the heating would have destroyed that danger. It was not spoiled tomatoes. Could the poison have come from the utensils used? They were cooked in a stone crock. That is made of fire-clay, with a salt glaze. It was for over a month in use, and the family were cleanly. The crock was examined by Dr. Bartley, the Chemist of the Board of Health; by Mr. F. N. Barrett, Editor of the *Grocer*, the leading paper of the canning interest; and myself,—all agreed it could not be that. Could it be from the spoon used in stirring? this was triple-plated, unworn, and clean.

That it came from the tomatoes, and that the poison was in solution, was shown from the fact that the oldest daughter had soaked her bread in the sop or liquid portion, and she suffered the most severely: she had not eaten of any of the tomatoes. The mother had also soaked her bread in the sop, but not liking the taste of it, she had not eaten much of it. She suffered next in severity. The second daughter had eaten the soft part, or "catsup part," as she called it. Her symptoms were next in severity to the mother's—while the boys and the nephew, who had partaken of the solid part, had got off the easiest, having had simply the severe cramps, colic, and finally vomited and laid round stupid that afternoon and evening, and in two or three days the pains in the abdomen were gone and they were at their play.

The first impression would be that it was lead, from the well-known effects of acid on lead, and the fact that lumps of solder are often found in cans as well as the solder that is used in making the joints. The red tongue, the severe colic, the thirst, and obstinate constipation looked like lead, but as the cases progressed, and we had the stupor, coma, colliquative sweats, and severe and continuous convulsions, it required some other poison besides lead to account for these. It was something more than an irritant. It was evident that they were suffering from some corrosive poison. What could it be? This is an extremely difficult question to determine—as admitted by all authorities on poison—when you have none of the original material to analyse. The length of time the poison might have been in the diluting mixture might also modify the usual symptoms. The fact that the mouths, tongues, and throats were not sore or excoriated, showed that the poison must have been in a diluted state, or it would have been noticed in the burning sensation produced in the mouth, and the first one who partook of it would have warned the rest. Nothing could be gained by the history from the family in regard to the smell of what had been vomited, or the colour or appearance to guide. The only statement was that the tomatoes tasted flat, and the addition of salt and pepper did not bring up the taste, and the colour of the tomatoes looked like a faded red. The mother did not pay much attention to the colour, because she thought that was because the yellow and red tomatoes had been stewed in the same kettle. The symptoms corresponded more nearly with verdigris poisoning, or the acetate of copper, and this seemed the probable cause, as it was a well-known fact that in these canning establishments large copper kettles are used, and verdigris frequently forms on these when acid fruits are stewed and allowed to stand. The kettles used in many of these establishments were known to be copper, and untinned and unprotected in any way from the action of acids.

Naunyn, in Ziemssen, vol. xvii., p. 590, reports that in the Vienna General Hospital there were 130 cases of poisoning produced in this way, that is, by boiling or preserving food in copper kettles, nine of which proved fatal. He also says all of these poisonings may become dangerous to life even when the amount of copper is not large enough to be clearly perceived by the taste. The symptoms laid down as resulting from verdigris poisoning are those of a severe gastro enteritis, the existence of great tenesmus, and pains in the large intestine. In comparatively many cases the nervous centres sympathise in a very large degree, as shown by the violent delirium, &c. Convulsions are not unfrequently observed. These symptoms are, however, noticed chiefly in those cases of copper poisoning caused by food in which the diagnosis is not perfectly clear. It was noticed that the tin was eroded from the head of the can around the cap, and how far the lead of the solder and the tin combined to make this poison was a matter of doubt. Taking one of these caps to a trained tinsmith, a flood of light was thrown upon the case. He showed me that the cap was not fastened to the head of the can by a resin amalgam, as the sides were, but that the amalgam was made of muriate of zinc—that is, pieces of zinc were placed in muriatic acid and dissolved, and more zinc then placed in the acid till the acid would no longer attack the zinc, and this saturated solution of muriate of zinc was painted into the groove of the head of the can. The cap was then placed on and held with a clamp, and the soldering-iron passed around. The iron being heated to a great heat, of course the solder held the acid in—it could not escape on the outside of the can, and if there happened to be too much acid applied to the groove, then as the tin expanded with the heat it would be forced into the can. That this muriate of zinc amalgam was painted on with a brush, that boys were employed for this purpose, and if they happened to get the brush too full this acid would be forced into the can. The can was coke tin. The terne tin being easily recognised from coke tin—the coke tin being known by its bright colour, while terne tin is dull and shows the lead in its composition. He said this was a very favourite amalgam with roofers, on account of the quickness with which it could be applied, but that good architects and builders would not allow of its use because it rotted the tin. This gave the explanation of the case.

The well-known effect of chlorine as a bleaching instrument would explain the faded condition of the tomatoes, while if the poison had been from the verdigris then the colour would be green from the staining of the verdigris. The same colour may be seen in the imported French peas, which are coloured with it, and which our health authorities still allow to be sold in the open market. The poison was a muriate of zinc and tin, the acid around the cap having eaten off the tin from the inside of the head of the can. If the acid had not got in the can and attacked this part of the tin there was no reason why this portion of the tin should not be as bright as the rest of the can. The inside of the can on the side where the resin amalgam was used was as bright as any other part, and the bottom of the can was also as bright around its edges as the rest. The contrast between these joints and that of the cap was so marked there could be no doubt of the poison. It was a double poison—muriate of zinc and muriate of tin. This, too, explained why it was that the eldest daughter had suffered the most. This poison had become dissolved in the liquid portion of the tomatoes. The oldest daughter had soaked her bread in the juice and eaten it, thereby getting the largest share of the poison. The mother, who was the next severest affected, had also soaked the bread in the juice, but, not liking it, had not taken much of it. While the second daughter took the catsup part, or soft part of the tomato, and was the next severest affected, the boys and nephew took the solid part and got off the easiest.

Chloride of Zinc.

Woodman and Tidy, p. 221, ed. 1887:—

"It is, moreover, a powerful corrosive poison. Several cases are recorded where it has been swallowed accidentally, and with fatal result. Applied externally, it is found to act as a powerful escharotic. The chloride of zinc differs in its action from all other zinc salts by its rapidly coagulating action on liquid albumen and on delicate tissues of the body. Its action on the living body is twofold: (1) It is a caustic and an irritant, producing pain and instant vomiting; and (2) it exerts a specific action on the motor or organic system of nerves; for, after the poison has been taken, the pulse and breathing are accelerated, the voluntary muscles become paralysed, the pupils dilate, coma supervenes, and death occurs without a struggle. The poison may be found in the tissues, urine, and blood."

"The heart is usually found distended, and the blood black and uncoagulated."

A. W. Blyth, Foods and Poisons, ed. 1878, p. 452, says:—

"Very serious illness has followed the ingestion of Burnett's fluid, in quantity equal to 12 grains of the chloride. Death has taken place from about 100 grs. of the chloride, and recovery after 200 grs."

The New York *Herald*, of April 18, 1883, and subsequently, had a series of canning articles, written by some one who thoroughly understood the business. And the danger of poisoning by the escape of this muriate of zinc flux into the can is specifically pointed out. He reports an interview with a veteran canner, who has sealed thousands of cans, who says that he knows that this muriate of zinc has got into the cans he has sealed; and also that this danger has been known in Maryland, and from the fact that *State of Maryland has a law prohibiting the use of this muriate of zinc flux.* That this acid will attack the tin, as well in a vacuum as out of it, is shown by the facts of the case. I took the care to examine a dozen cans where this muriate acid amalgam was used, and in all of them there was more or less of the tin dissolved off. In the *Herald* article was the report of Prof. E. B. Stewart, Secretary of the Illinois Microscopical Society. He said:—

"I take the liberty of calling your attention to a source of danger, until now unsuspected by me, from the use of canned vegetables, an instance of which came to my notice by happening to observe in my kitchen, a few days since, a can which had contained lima beans. The appearance of the upturned lid attracted my attention, and on examining the interior of the can more closely, I found that the coating of the tin had been almost entirely dissolved from the iron, only patches remaining in places to show that it ever had been tinned. A portion of its contents was submitted to proper chemical tests, which revealed the presence of tin in large quantity. It is probably well known to your readers that tin is, when taken into the system, poisonous. It has an irritant, caustic, and astringent action; and in extreme doses, convulsions, and sometimes paralysis, occurs. Like most other minerals it may, when constantly taken in small doses, be retained till serious symptoms appear, and while the use of a single can of vegetables containing a considerable quantity would not be followed by fatal results, the constant use of food strongly impregnated with this metal would, in time, be likely to produce serious consequences. Manufacturers should not find it a difficult matter to secure non-poisonous material for making of cans. By simply leaving the thin plate of tin off the iron, a package is obtained which, for most vegetables, is unobjectionable; and in those cases where discolouration might follow the use of bare iron, a japanned iron might be substituted. The use of solder can also be done away with by substituting a very hard cement like the ordinary can wax, which is perfectly insoluble in the acid or other proximate principles of fruits and vegetables. Is it not possible that the corrosion in this case was from the muriate of zinc amalgam, as in my case the tin was attacked?"

The position the French Government has taken with regard to the danger from the lead poisoning in the cans, can be best judged from the regulations established by the Director-General of Customs of France. I quote from the *Herald*:—"The Consulting Commissioner of Hygiene, to whom the question has been submitted, is convinced that, as far as the public health is concerned, there are serious objections to permitting the sale of products which, from contact with solder, or with surfaces covered with an alloy containing lead, might become the cause of poisoning. The Commissioner has, consequently, reported that there is reason to forbid makers of cans for alimentary conserves to solder on the inside of such cans, or to employ, in the manufacture of their cans, tins of other than the best quality. The Commissioner of Hygiene has added that if manufacturers insist on soldering on the inside of the cans, they ought to be obliged to use pure tin exclusively."

The legal aspect of this question is a matter of interest I quote from chapter xii. of Elwell's "Medical Jurisprudence." "It is a well established principle of law that a vendor of provisions for domestic use is bound *to know* that they are sound and wholesome, at his peril (Van Brachlin *vs.* Fonda, 12 Johnson's Reports, 468). It is an equally elementary principle that in contracts for the sale of provisions the party, by implication, who sells them, undertakes to guarantee that they are sound and wholesome (3 Blackstone, 165). Blackstone also says: Injuries affecting a man's health are, when by any unwholesome practices of another, a man sustains any apparent damage in his vigour on constitution, as by selling him bad provisions or wine; by the exercise of a noisome trade or by the neglect or unskilful management of a physician, surgeon, or apothecary. These are wrongs or injuries unaccompanied by force, for which there is a remedy in damages by a special action on the case (3 Chitty Black, 91). Second: The action will accrue not against the last vendor when the goods are sold in sealed packages, but against the original manufacturer. This is a point settled by the courts for many years. Notwithstanding, in the course of trade, the goods have passed through many hands and are finally bought and used by one who is injured thereby, the original maker is liable to the person so injured and not to the grocer who, relying on the correctness of the label, innocently sells the article for what it is not. If, however, that grocer knows that the article is dangerous or if that knowledge is possessed by any of the parties through whose hands it has passed, if he knows that the article is dangerous, then he cannot evade the responsibility of his unlawful act. An extremely interesting case bearing on this point was taken to the court of last resort and is reported in chapter 12 of Ewell's "Medical Jurisprudence."

The case is Thomas and wife *vs.* Winchester (Second Selden's Reports, N. Y. Court of Appeals, 397). The facts proved in the case were briefly these: Mrs. Thomas being in ill health, her physican prescribed for her a dose of dandelion. Her husband purchased for her what was believed to be the medicine prescribed at the store of Dr. Foord, a physican and druggist, in Cazenovia, Madison Co., where the plaintiff resides. A small quantity of the medicine thus purchased was administered to Mrs. Thomas, on whom it produced very alarming effects, such as extreme coldness of the surface and extremities, feebleness of circulation, spasms of the muscles, giddiness of the head, dilatation of the pupils of the eyes, and derangement of the mind.

She recovered, however, after some time, from its effects, although for a short time her life was thought to be in great danger. The medicine administered was *belladonna* and not dandelion. The jar from which it was taken was labelled "½ lb. dandelion, from A. Gilbert, 108, John Street, N. Y., Jar, 8 oz."

It was sold for, and believed by Dr. Foord to be, the extract of dandelion, from Jas. S. Aspinwall, a druggist of New York. Aspinwall bought it of defendant believing it to be such. The defendant was engaged at 108, John Street in the manufacture and sale of certain vegetable extracts for medicinal purposes, and in the purchase and sale of others. The extracts manufactured by him were put up in jars for sale, and those that he purchased were put up by him in like manner. The jars containing extracts manufactured by him and those containing extracts purchased by him from others were labelled alike. Both were labelled like the jars in question, as prepared by A. Gilbert. Gilbert was a person employed by the defendant at a salary, as an assistant, in his business. The jars were labelled in Gilbert's name, because he had previously been engaged in the same business on his own account at 108, John Street, and probably because Gilbert's name rendered the article more saleable. The extract contained in the jars sold to Aspinwall, and by him to Foord, was not manufactured by the defendant, but was purchased by him from another manufacturer or dealer.

The extract of dandelion and the extract of belladonna resembled each other in colour, consistence, smell, and taste, but may, on careful examination, be distinguished, the one from the other, by those who are well acquainted with the articles. Gilbert's labels were paid for by Winchester and used in his business with his knowledge and consent.

The Court of Appeals sustained the principles laid down above, in the following words:—

"The sale of the poisonous article was made to a dealer in drugs, and not to a consumer. The injury therefore was not likely to fall on him or on his vendee, who was also a dealer, but much more likely to be visited on a remote purchaser, as actually happened. The defendant's negligence put human life in imminent danger; can it be said that there was no duty on the part of the defendant to avoid the creation of that danger by the exercise of greater caution, or that the exercise of that caution was a duty only to his immediate vendee, whose life was not endangered? The defendant's duty arose out of the nature of his business and the dangers to others incident to its mismanagement. Nothing but mischief like that which actually happened could have been expected from sending the poison falsely labelled into the market, and the defendant is justly responsible for the probable consequences of his act."

Not only can the canners be made to respond in damages for the continuance to use this virulent poison in their soldering, but they can be made to respond in exemplary damages—that is, the jury may not only award the actual damages they determine a party has suffered, but also such a sum as will make an example of these wrongdoers, so as to deter others *from this wilful tampering with human life*.

What are the facts of the case? The danger of this muriate of zinc flux is so well known that its use is prohibited by the laws of Maryland. These dangers have been so thoroughly exposed by the *Herald* more than a year ago; their trade journals have fully discussed the matter, so they cannot plead ignorance of this danger. Their representative men are here to-night, and these cases are brought to their notice. Safe measures can be adopted instead of dangerous ones. The resin that makes the outside seam tight will also make the seam on the cap equally safe.

When a man uses a dangerous means when he could have used a safe one, and human life is imperilled thereby, he cannot escape the consequences of his act. Those that still believe otherwise would profit by reading the cases of Fleet and Semple *v.* Hollencamp, reported in Chapter XII. of Elwell's "Medical Jurisprudence." The case was taken to the highest court in Kentucky, and exemplary damages sustained through every court, and by that of last resort. In this case Hollencamp had had a prescription of Peruvian bark and snakeroot put up at Fleet and Semple's drug store, and their clerk carelessly ground up the bark and snakeroot in a mill in which Spanish flies or cantharides had been ground before. The clerk neglecting to clean the mill, the Spanish fly became mixed with the plaintiff's prescription, and he, taking it, thinking it was the medicine ordered by his physician, received serious harm. The Court of Appeals says—"Whether exemplary damages should or should not be given does not depend on the form of action so much as upon the nature and extent of the injury done, and the manner in which it was inflicted, whether by negligence, wantonness, or without malice. In these cases, instead of caveat emptor, it should be caveat vendor. The excuse that it was an accidental or an innocent mistake will not avail him, and he will be liable, at the suit of the party injured, for damages *at the discretion of the jury*." In the same decision, in response to the question argued by the attorney for the druggist, as to the druggists being insurers, the Court of Appeals said—"We see no good reason why a vendor of drugs should in his business be entitled to a relaxation of the rule which applies to vendors of provisions, which is that the vendor undertakes and insures that the article is wholesome. Sound public policy in relation to the preservation of health, and even of life, would seem to require that this rule should have a rigid and inflexible application to cases similar to the one under consideration."

A suggestion was made to me by a manufacturer, of a reason why this poisonous amalgam should not be allowed. It is well known that all labour organised has its trades' unions. When a dispute arises between the union and the employers, if the union cannot carry their measures by fair means they use foul. Malicious mischief is the rule. In his own business glass factory there was a strike. Some of the union men refused to strike. He found that he could not walk across the floor without the glassware breaking to pieces. They had dropped something into the glass while the annealing was going on that rendered it so brittle as to be worthless. He mentioned in other trades how the same malicious mischief had been accomplished. Now, suppose a strike takes place and malicious mischief is ordered, how easy to drop a teaspoonful of this poisonous muriate of zinc into some of the cans to hurt the proprietors' business. Surely such a virulent poison should not be too handy. It should not be allowed by any State law, or tolerated by the manufacturers themselves.

It has been asked, What is the use of your trying to effect a change in this form of soldering the caps? The Canned Goods organisation is so powerful that it can override even State legislation; and they instance the Bill at Albany this season to prevent canned goods over a year old being sold in this State. I believe that the canners themselves will make the change.

History repeats itself. A quarter of a century ago all pickles sold in England were coloured by verdigris. It was poisonous—sickness ensued from eating them. Prosecution after prosecution was instituted against the manufacturers for a violation of the law. By the aid of able lawyers they were enabled to escape. The public began to be demoralised; they were afraid to use the coloured pickles, and the trade suffered.

Crosse and Blackwell came to the front; they made an honest, uncoloured pickle. Every bottle of pickles sold by them bore the label,—"These pickles do not have the fine green colour usually seen on pickles, for that colour is produced by verdigris, which is poisonous. These are honest pickles, put up in pure cider vinegar." They trusted the public and the public trusted them, and the enormous fortune they made showed how great was the reward to him who restored the public confidence in a necessary article of food. So with the wavering confidence of the public in canned goods, the trade will see to it themselves that confidence is restored, or their business is gone. Doubt will kill the business. If a mother dreads when she is putting food before her children that she is giving them poison, then she will no more give them that food than she will give them so much poison.

To sum up:—

1st. These were not cases of sickness from spoiled tomatoes.

2nd. They were cases of corrosive poisoning from muriate of zinc and muriate of tin.

3rd. This poisonous amalgam must be abandoned.

4th. Exemplary damages, "at the discretion of the jury," will be sustained by the courts for this reckless tampering with human life in using a dangerous means when a safe one could be used.

5th. The canners have only themselves to thank for the present panic in their business, for they have persisted in this dangerous plan, knowing it was dangerous.

6th. Every cap should be examined, and if two holes are found in it, send the can at once to the Health Board, with the contents and name of the grocer who sold it.

7th. Reject every article of canned food that does not show the line of resin around the edge of the solder of the cap, the same as is seen on the seam at the side of the can.

8th. Reject every can that does not have the name of the manufacturer or firm upon it, as well as the name of the company and the town where manufactured; "standards" have all this. When the wholesale dealer is ashamed to have his name on the goods, fight shy of them.

9th. Press up the bottom of the can; if decomposition is commencing, the tin will rattle the same as the bottom of the oiler of your sewing-machine does. If the goods are sound it will be solid, and there will be no rattle to the tin.

10th. Reject every can that shows any rust around the cap on the inside of the head of the can. If housewives are educated to these points, then muriate of zinc amalgam will become a thing of the past, and dealers in "swells" have to seek some other occupation.

THE LATE PETER SQUIRE.

ADDRESS DELIVERED AT THE CEREMONY OF UNVEILING A PORTRAIT-MEDALLION OF THE LATE PETER SQUIRE, AT THE PHARMACEUTICAL SOCIETY OF GREAT BRITAIN, ON MAY 20TH, 1885.

By Sir SPENCER WELLS, Bart., F.R.C.S.

Ladies and Gentlemen,—I have not yet seen this medallion, but I have just seen a portrait for the first time in the Council Room, and we shall be able to compare this likeness with that. I do not know whether it can be seen from all parts of the room [Sir Spencer Wells unveiled the medallion amid loud applause]. I had the opportunity of seeing this when it was in the state of clay, while Mr. Brock was modelling it,—Mr. Brock, whom you all know by reputation as a sculptor, a great many personally, and many by his works. Some of them are in this year's Exhibition of the Royal Academy—the statue of Sir Erasmus Wilson, and an excellent bust of Captain Hanham, an old friend of mine, who is perhaps not so well known. Mr. Brock wished me to say to you that he was sorry not to be able to be present, and that he had not had the advantage of a personal acquaintance with Mr. Squire,—indeed, he never saw him, so that the likeness is taken from photographs and from the picture now in the Council Room, assisted by the critical remarks of relatives and friends. But I should say it is a very striking likeness, not of Mr. Squire as many of you remember him in his later days, but when he was in the full vigour of his active life. The medallion represents a man of some fifty or sixty years of age, full of vigour, and not looking quite so stern as the likeness which is in the Council Room. That is probably the face that he would have in this room when he was examining some pupil not very well up to his work. This medallion strikes me as being a good likeness of Mr. Squire as he was in the days when he was doing some of the good work which so many are here to honour.

Ladies and Gentlemen,—I am not going to trouble you by reading many extracts from the different notices which appeared in the *Pharmaceutical* and other journals about Mr. Squire soon after his death; but I should like to read one extract from a very interesting work of Dr. C. J. B. Williams called "Memoirs of Life and Work." His son is here to-day, and will probably say a few words expressive of the feeling which very many members of the medical profession had for Mr. Squire, and how much they value the association of the work of the pharmaceutical chemist with their own work, and how very desirable it is that they should be supplied with properly prepared drugs, which really represent the active principles of the plants from which they are derived. This extract from Dr. Williams's work expresses the feeling with which a very large number of the medical profession regarded Mr. Squire. Dr. Williams says, "I always felt a strong desire to improve our pharmaceutical knowledge, not only by acquisition of new remedies, but also by more exact information of the true modes of operation of the old, and of the best methods of preparing and combining them. And with this view I found the advantage of cultivating the acquaintance of the most intelligent and advanced pharmaceutists, and I feel sure that I profited much by the informrtion which I obtained from them. Foremost among them was my friend Mr. Peter Squire, to whom British Pharmacy is deeply indebted, not only for his standard work "Companion to the British Pharmacopœia," which has gone through fifteen or sixteen editions, and has no equal for amount and exactitude of information,—but also for the success of his work in vegetable pharmacy, particularly in improving the preparation of extracts, so as to preserve their remedial properties. When I first began to practise, I had little faith in vegetable extracts; for they were of doubtful efficacy, and all seemed much alike in their dark treacly aspect and empyreumatic odour, very unlike the herbs from which they were prepared. But when I came to see Squire's extracts, preserving most of the colour, odour, and characteristic taste of the fresh plant, I began to believe in them, and on trial proved their efficacy—that of *Taraxacum*, for example. I believe that the improvement consisted chiefly in avoiding a high temperature in concentrating the extract, and promoting evaporation by either diminished pressure, or more simply by an increased current of air. A similar plan is now adopted by most manufacturing druggists. Mr. Squire has been also very successful in improving the taste and action of opium, and of spirits of wine, by eliminating from them an offensive and noxious ingredient; and he has made several valuable suggestions for the improvement of the processes in the National Pharmacopœia." On this point Dr. Garrod, who is here, and who was one of the co-workers with Squire in arranging our present Pharmacopœia, and in bringing together the Scotch, the Irish, and the English Pharmacopœias so as to form one British work, will tell you something about the ability, energy, and industry with which Mr. Squire worked. I may add something to what Dr. Williams has said as to the care Squire took in preserving the active principles of vegetables. In some of the memorial notices of Squire it is told how Sir James Clark (who was Physician to the Queen) was struck by the care with which Mr. Squire worked in these matters, and he went to him without saying who he was, and after most careful inquiry as to his character and knowledge, obtained for him the appointment he held for forty years afterwards, of Chemist to the Queen. About that time I formed his acquaintance. I was introduded to him more than forty years ago by Sir James Clark, and at that time, as Dr. Garrod knows better than anyone else, there was a great deal of interest about the active principle of colchicum, and as to the various strengths of different tinctures that were prepared from the seeds and so-called roots. Mr. Squire, in order to avoid the varying strength of the tincture prepared from the partly dry root, or from the seeds, did what he could to obtain a more equable tincture by using the flowers. He knew very well that the flowers varied a little in strength according to the season when they were gathered, whether it was dry or wet; but there was not nearly so much difference as that which was obtained by using fresh or old roots and seeds. I saw a great deal of him then, and one could not but notice the great care with which he made the preparations of colchicum and a variety of vegetable extracts, and which he took in getting a more stable and uniform preparation of opium. This was the commencement of a friendship which lasted as long as he lived. I can say that, during some forty years, I knew no more pleasant acquaintance, and I can look back to no friendship or acquaintance which has given me more satisfaction, or which I recall with more pleasure. (Applause.) One of the events in the life of Mr. Squire, in which he made himself useful to the medical profession, has hardly been sufficiently noticed in some of the memoirs of him—I mean the use of ether in the production of anæsthesia. When anæsthesia was first heard of in England, Mr. Squire constructed the apparatus with which the first experiment in this country was made by Mr. Liston. That apparatus is now in the museum of University College Hospital. I was the first to make use of it in the Mediterranean, where I was at that time, in Malta. I wrote to Mr. Liston to send me an apparatus for the use of ether, and it was sent out by Mr. Squire, and used by me for the first time in the island of Malta. The very first experiments made were those made with this apparatus of Squire's and others very similar to that which is now in the University College Museum. His friendship with Mr. Liston lasted as long as Liston lived, and I have a curious memento here of the friendship of Liston for Squire—it is not quite the thing to bring into an assemblage of ladies; for it is a rifle with which Liston, who was a great enemy of cats (laughter), used to destroy all the cats that came within range of his bedroom window. It was used for a different purpose by Squire. He used it principally for shooting rooks, and within the last two years of his life I have seen him shoot rooks in my own grounds with this rifle without any spectacles, showing the keenness with which his eyes retained their perfection to the last. At that time I remember, one day when he was shooting rooks with this rifle, I said to him, "How is it, Squire, that you, at eighty-four ears of age, retain all your vigour and all your enjoyment of field sports like a boy?" "Well," he said, "it is perpetual activity of mind and body," and I suppose that was the secret. (Hear, hear). All his life through he was a man of extremely active habits—always working. You may see in some of the memoirs that, after a hard day's work he would go home and continue to work, perhaps making astronomical observations, and then be up very early in the morning making botanical excursions. Throughout his career he lived a life of continual activity, as he said, both of mind and body. Among the most useful of his many good works is the foundation of this Society, of which he was three times President, and the important part he took in founding the College of Chemistry. Of his work on the Pharmacopœia Dr. Garrod will tell you more, and I will not delay you longer. I might have said something about his family and about the very interesting relics that some members of the family have of the Squires in long bygone years: amongst others an old book showing that one of the former Squires had served with Cromwell's Ironsides and had marked in the Prayer Book which was "the favourite psalm of the Lord Protector" and which was the "favourite psalm of King Charles;" how they "sang this psalm at Marston fight," and how the "Lord General gave the order"—then the "favourite hymn of Cromwell," and the "favourite hymn of King Charles"—"how the poor King fled and the Lord was not with him," and a variety of things of this kind with which I can hardly detain you now. But I would just say, that one of the earliest of Squire's introductions was what is now so common—the electric light. During some of the peace illuminations an electric light excited by Squire's battery threw a light along Oxford Street, up to the Marble Arch and towards the Circus, which was a wonder to the people of that day. In conclusion, allow me to express the hope that the work which Squire commenced, and which has been long carried on by this Society, will be continued. It will not do to allow anyone to practise as a chemist and druggist without some such guarantee as to ability and knowledge as that which the diploma of this Society affords to the public. There have been samples of different tinctures obtained quite lately from some of the principal druggists of this city: tinctures of belladonna and tincture of opium in which the amount of the active principle has varied as much as 50 per cent. Some of them have been less than half the strength of the others, and I have no doubt in some of the inferior manufactories still greater differences will be found. I would repeat in conclusion that the old age of Mr. Squire was an old age of great activity, and I will read to you an extract from a very interesting lecture on old age which was delivered the other day at the Medical Society by Professor Humphry. He says, "Length of life is to be estimated not by number of years so much as by good work done—not by the amount of time spent in the tame fruitless manner indicated by the pithy words of Cowper—

> "For fourscore years this life Cleora led:
> At morn she rose, at night she went to bed"—

nor by endeavours solely to advance our own fortunes, or reputation, or comfort, but by perserving efforts to promote the welfare of our fellow men." That I believe to be the aim and object of this Society, of which Squire was three times President, and I hope that those who follow him will go on in the same course, and that every member of this Society after many years of like usefulness may be assured of a like reward. (Applause.)

PROCEEDINGS OF SOCIETIES.

ROYAL INSTITUTION OF GREAT BRITAIN.

General Monthly Meeting, Monday, June 1, 1885,

The Duke of Northumberland, D.C.L., LL.D.,
President, in the Chair.

The following gentlemen were elected Members of the Royal Institution:—Raphael Meldola, F.C.S., F.I.C., and Colonel George Swinton, R.E.

The presents received since the last meeting were laid on the table, and the thanks of the Members returned for the same.

Salicylisation of Food.—A number of pots of preserved fruits manufactured at Rouen contained from 0·153 to 0·600 grm. salicylic acid per kilo. This acid did not evidently prevent fermentation nor the formation of mould on the surface of the pots.—*Journal de Pharmacie.*

CHEMICAL NOTICES FROM FOREIGN SOURCES.

Note.—All degrees of temperature are Centigrade unless otherwise expressed.

Journal für Praktische Chemie.
Vol. xxxi., Part 4.

On Albumen and its Oxidation.—Oscar Loew.—It is inconceivable that the many different bodies which may be formed from albumen under various influences can pre-exist in its molecule. It is rather probable that albumen, in consequence of the specific positions of its atoms, readily admits of re-arrangements. The question what atomic groups pre-exist in albumen is therefore difficult of decision. Oxygen does not exist in ordinary albumen in the form of keton- or aldehyd-groups. Whilst on the decomposition of albumen by acids and strong bases the nitrogen appears in the form of amido-groups and ammonia, not more than a third of such nitrogen in albumen and peptone pre-exists in the form of amido-groups. The view that leucine pre-exists in albumen is not supported by the behaviour of the latter with perosmic acid and potassium permanganate. The first changes of albumen on oxidation with permanganate are that it loses the property of giving Millon's reaction. On further oxidation it ceases to give a precipitate with phospho-tungstic acid. The final products of oxidation with permanganate are benzoic, succinic, acetic, formic, and oxalic acids, hydrocyanic acid or oxamide, carbonic acid, and ammonia.

The Action of Chloro-carbonic Oxide upon Glycol-chlorhydrine.—Jacob Nemirowsky.—The product of the reaction is chlorethyl-chloroformic-ether.

On Polymeric Dichlor-acetonitril.—A. Weddige and M. Körner.—On the prolonged passage of dry hydrochloric acid into ordinary dichlor-acetonitril, the authors obtained a white crystalline addition-product, which, if if heated to 130° to 140° for some hours in a sealed tube, is split up into its components, the dichlor-acetonitril being at the same time polymerised.

Journal de Pharmacie et de Chemie.
Vol. xi, No. 8.

On Glycol.—G. Bouchardat.—The author prepares glycol by the process of Zeller and Huefner. He finds that it solidifies very rapidly under the influence of cold and vibration at temperatures ranging from −13° to −25°. Glycol possesses in an eminent degree the power of remaining in a state of superfusion.

On Glycol Mono-chlorhydrate.—G. Bouchardat.—For the preparation of this compound the author recommends the employment of crude glycol slightly hydrated.

On the Arbutus and on Arbutine.—J. Dalmon.—A pharmaceutical study.

New Application of Phenol-phthaleine in Volumetric Analysis.—E. Léger.—The author has observed that, contrary to what takes place with the mineral alkalies, certain organic alkalies have no action upon phenol-phthaleine. This property enables him to make use of this indicator in the determination of acids in alkaloidal salts. The indifference of most vegetable bases to phenol-phthaleine, far from restricting the use of this reagent, enables it to be used in cases where hitherto nothing can be substituted for it. It is possible to determine volumetrically an acid combined with certain alkaloids as easily and accurately as a free acid. This determination may serve, within certain limits, to detect the purity of an alkaloidal salt. We may take as an instance basic quinine sulphate. The determination of the sulphuric acid in a portion of the salt dried at 100° will detect any fraud with neutral matters, since, on the one hand, this salt must contain a definite proportion of sulphuric acid, and, on the other hand, its neutrality to litmus cuts off fraud by the addition of acid. If we finally submit quinine sulphate to Kerner's test, which enables us to detect foreign alkaloids, we have all the elements of a good array of this compound.

On a Pretended Synthesis of Saccharose.—MM. P. Cazeneuve and G. Linossier.—An exposure of the pretended electric conversion of potato-starch into saccharose. The trick (worthy of the later alchemists) consisted in neutralising the acid liquor after the passage of the electric current, not, as was supposed, with calcium hydroxide, but with calcium saccharate!

Poisoning by Brass Taps used for Drawing Wine.—M. Andouard.—Some white wine, suspected of being the cause of violent vomiting and colic in persons who had partaken of it, was found to contain per litre 116 milligrammes of copper besides a quantity of zinc. On substituting a wooden spigot the mischief no longer occurred.

Coal-tar Colours in the Artificial Flower Trade.—Since carmine has been abandoned in favour of eosine reds, colics and painful spots on the skin have become common among girls employed in the manufacture of red roses. The eosine lakes employed have a lead-base, and the substitution of aluminous lakes is recommended.

Justus Liebig's Annalen der Chemie.
Vol. ccvii., Part 3.

Researches from the Chemical Institute of the University of Strassburg.—These consist of a paper by E. Scherks on oxymaleic and oxycitraconic acids; a memoir by R. Fittig and H. Erdmann on the synthesis of α-naphthol; an examination of the action of sulphuric acid upon the two phenyl-crotonic acids, by H. Erdmann; and a paper by Paul Trinius on derivatives of hydratropasic acid and the artificial formation of phloretinic acid.

On the Terpenes and the Ethereal Oils.—O. Wallach.—The author finds from his investigations that a very large number of the terpenes known under different names and considered as distinct are, in fact, identical; *e.g.*, the portions of hesperidene, citrene, oil of bergamotte, carven, oils of dill, of erigerone and of pine-leaves, boiling between 175° and 176°; secondly, the terpenes boiling between 180° and 182°, cinene, cajeputene, caoutchine, diisoprene, with the parts of camphor oil boiling at corresponding temperatures, and of that product which is formed by heating all the terpenes hitherto examined to 250° to 270°. Lastly, all the hydrocarbons obtained by decomposing terpen-dihydrochlorate by melting at 49° to 50° with aniline are identical with these bodies. In how far the mutually very similar terpenes, boiling at 160° and occurring in oil of turpentine, oil of pine-leaves, of juniper-berries, lemons, eucalyptus, mace, dill, sage, &c., are identical can not be certainly inferred from existing observations. At elevated temperatures they all pass into the same terpene. Whether they behave similarly on inversion with sulphuric acid it has yet to be determined. The author proposes a new classification of these bodies, distinguishing A, hemiterpenes or pentenes of the formula C_5H_8, including isoprene and valerylene. And B, true terpenes, $C_{10}H_{16}$. These are resolved into several groups chemically distinct, each including various members differing essentially by their optical behaviour. The best characterised groups are the pinenes, the camphenes, the limonenes, and the dipentenes, a fifth and a sixth group being doubtful; C, the polyterpenes $(C_5H_8)x$, which are again divided into sesquiterpenes or tripentenes, diterpenes or tetrapentenes, and polyterpenes proper.

Communications from the Chemical Laboratory of the University of Erlangen.—These include a continuation of an investigation of the hydrazines of cinnamic acid, by E. Fischer and J. Tafel; a paper by A. Elbers on certain combinations of the hydrazines with ketonic and aldehydic acids; a memoir by the same chemist on compounds of benzaldehyd with aniline hydrochlorate and tin chloride; a paper by O. Antrick on benzylindol, and an account by the same author of certain combinations of diacetonamine with aldehyds.

On Acetyl-acetacetic Ether.—A. Geuther.—The author accounts for the circumstance that Dr. James, in his account of acetyl-acetacetic ether, overlooks two papers published respectively by M. Elion and Prof. Franchimont.

NOTES AND QUERIES.

*** Our Notes and Queries column was opened for the purpose of giving and obtaining information likely to be of use to our readers generally. We cannot undertake to let this column be the means of transmitting merely private information, or such trade notices as should legitimately come in the advertising columns.

Purification of Alcohol.—Will some correspondent inform me of a simple process of parting naphtha from methylated finish, so as to procure pure alcohol?—J. B.

Chemical Plumbing.—Would you kindly let me know, through the medium of your paper, if I can get a work on Chemical Plumbing, and where?—AN ACID MAKER.

MEETINGS FOR THE WEEK

TUESDAY, 9th.—Royal Medical and Chirurgical, 8.30.
—— Photographic, 8.
WEDNESDAY, 10th.—Geological, 8.
—— Microscopical, 8.
THURSDAY, 12th.—Royal, 4.30.
—— Philosophical Club, 6.30.
—— Mathematical, 8.
FRIDAY, 12th.—Astronomical, 3.
—— Quekett Club, 8.
SATURDAY, 13th.—Physical, 3. "On the Winding of Voltmeters," Prof. Ayrton, F.R.S., and Prof. J. Perry.

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THE CHEMICAL NEWS.

Vol. LI. No. 1333.

ON A NEW FORM OF COMBUSTION-TUBE.

By THOMAS T. P. BRUCE WARREN.

Where several combustions have to be made in succession, any modification which renders the operation more simple, and is also free from the serious objection of faulty connections, is too obvious to need comment.

By this arrangement the india-rubber cork which closes one end of the combustion-tube, and which is perforated to take the end of the chloride of calcium tube, is dispensed with, and the end of the combustion-tube is drawn out to a taper of suitable length, the same size in external diameter as the chloride of calcium tube; a piece of unvulcanised india-rubber tubing is pushed over the drawn-out end, which secures also the chloride of calcium tube.

Mitscherlich adopted the drawing out of the combustion-tube, but there are several objections to his method which renders that plan quite unfit for the present purpose.

The other end of the combustion-tube, instead of being fitted with a perforated caoutchouc cork, has a caoutchouc cap which is drawn tightly over the tube, and through the perforated cap passes the tube for conveying air or oxygen over the contents of the tube, and which, of course, keep the same end comparatively cool during the combustion.

By giving the necessary inclination to the furnace it is impossible for any water which may condense in the fore part of the tube falling back against the heated part of the tube, whilst the necessary slope favours its passage into the chloride of calcium tube.

With an ordinary straight tube closed with an india-rubber cork in the usual way, it is impossible to avoid water condensing in the front part of the combustion-tube, and very frequently it is necessary to pass a rapid current of air or oxygen at the end to carry it over. Sometimes water will collect between the rubber cork and end of the combustion-tube, when a long time is necessary to carry it over.

The tube thus prepared may be filled as suggested by Sir H. Roscoe by first inserting a previously ignited copper plug, pushing the same down as far as it will go, and then filling up the necessury length of the tube with granulated oxide of copper, and then inserting another plug of copper gauze; beyond this is inserted the platinum boat with the substance to be burnt, and finally an ignited and cooled cylinder of copper gauze.

The only suggestion which may be made here is with respect to the filling of the fore part of the tube. Sometimes a little oxide of copper may be carried forward into the drawn out part of the tube and possibly into the chloride of calcium tube. To avoid this, it is better to fill the taper end with acid washed and ignited asbestos, in long fibre, very loosely packed in; this is afterwards pushed towards the copper plug with a clean wire, so as to leave the front part of the taper quite clean.

The front part of the tube may be kept quite clean and free from loose oxide of copper by filling the tube with clean copper turnings, which are carefully ignited and oxidised in the tube.

The objection to closing the front part of the tube with an india-rubber cork, perforated to allow the chloride of calcium tube being inserted, is principally due to the risk of removing the same adhesion or removal of particles of the rubber to the chloride of calcium tube, and if the rubber cork should become heated when air or oxygen is passed, some volatile products may be carried forward to vitiate the result.

Any portions of the heated tube should be exposed as little as possible at the junctions to the india-rubber surfaces; the glass tubes should meet so as to avoid this as far as practicable. Besides the result arising from oxidation, we must not forget that india-rubber is liable to take up water.

With proper care in obtaining the residue this arrangement secures accuracy in the determination of organic carbon in a water residue. The only precautions are to wash the oxygen by passing through caustic potash, when collecting it in a gas holder; the oxygen when used for the combustion is passed through several tubes filled with fused sodic hydrate, and finally dried by bubbling through strong sulphuric acid. The chloride of calcium tube used for taking up the water formed during the combustion may with advantage be replaced with a set of Liebig's potash bulbs containing strong and pure sulphuric acid. When quite ready a blank test should be made.

Messrs. How and Co., of Farringdon Street, have kindly undertaken to supply these tubes, which must prove of great convenience in the ultimate analysis of hydrocarbons.

NOTE ON THE MOTIONS OF CAMPHOR PARTICLES ON THE SURFACE OF WATER.

By THOMAS HART, Assoc. R.S.M.

The reasons assigned to the motions of camphor by Mr. Casamajor, in a paper on this subject lately published in the Chemical News (vol. li., p. 109), appeared to me to be quite inadequate to account for these remarkable phenomena.

The author of the paper to which I refer, having shown that the motions were in no way connected with the phenomena of frictional electricity, attributed the cause to two separate facts.

1. That the specific gravity of camphor is lower than that of water.
2. That camphor is perceptibly soluble in water.

It will be necessary simply to state (1) that there are numbers of other materials which are lighter than water, and (2) that no less than "1000 parts of water are required to dissolve 1 part of camphor" ("Allen's Organic Analysis," vol. ii., p. 59). The following experiments show that an altogether different hypothesis is required by the facts of the case.

(1.) A small piece of camphor placed upon a glass slide and examined under the microscope is seen to grow smaller and smaller, more and more rapidly, while minute atoms of camphor make their appearance in the field not far from the main mass of camphor.

(2.) Another similar piece of camphor, placed this time upon a drop of water, and examined under the microscope as before, gives a very similar result. But this time the camphor wanes or wastes away much more rapidly than before, and is also observed to be undergoing a state of rapid oscillating movement. Visible particles are thrown off from its surface, and the water itself is in a state of motion.

(3). A small piece of lighted camphor is next placed upon an extended surface of water; the more extensive the better are the effects. The phenomena which occur are familiar to all of us.

The lighted particle traverses the water rapidly, taking first one direction, then another, and sometimes travelling in a series of eccentric or even concentric curves.

In front of the travelling particle a series of ripples are to be seen; while behind, the flame which is blown backwards frequently touches the water, leaving a black streak on its surface.

As the camphor burns a rim or flange is formed round the particle at the water's edge. This is no doubt produced by the melted camphor becoming cooled and solidified at this point.

Occasionally a small portion of the camphor breaks away from the mass, and darting off begins a series of movements which are far more rapid in character than those performed by the original or "parent" piece, and very soon the particle thus separated disappears altogether.

Now these phenomena are attributable to two distinct causes.

In the first place, the want of cohesion between the particles of the camphor allows a gradual dissolution of its mass.

Secondly.—The ready adhesion of the separated particles to the surface of the water upon which the mass rests causes these to spread over the surface.

In other words, "The camphor, owing to the incoherence of its substance, and owing to its adhesive properties with water, tends to spread itself over the surface of the water, and in doing so, motion of the particles gives rise to motion of the mass."

To the fact that these conclusions are accurate the following circumstances most fully testify.

Any cause which will increase or decrease the *cohesion* of the camphor mass will at the same time decrease or increase the rapidity of its motions.

By raising the temperature but very little, the rapidity of the movements was greatly increased, the cohesion being of course diminished.

By rendering the mass more compact by pressure the motions were found to be diminished in intensity and rapidity. This may have been only an apparent difference, due to the fact that a greater weight had to be moved for the same volume.

Any cause, on the other hand, which will increase or decrease the powers of *adhesion* to the water surface will increase or decrease the rapidity and intensity of the motions.

And this is seen to be the case. For the smaller the atom the greater the surface in comparison to the mass, and consequently the more rapid the movements.

And, again, if a small log-shaped piece of camphor be gummed to a piece of paper and the whole floated on the water, when the camphor is lighted the whole will travel in a linear direction, and not in the usual uncertain and indirect fashion, as occurs when lighted particles are by themselves employed.

Thus, by limiting the surface for adhesion, the direction of the movement has also been limited.

Finally, it will be admitted by all that, as a final verification and crucial test, if we can obtain a material which, *firstly*, possesses this want of cohesion between its particles, allowing of a gradual dissolution of its mass; in which, *secondly*, the separated particles possess the property of adhesion to the surface of water, this hypothesis will be distinctly proved; that is, if, and only if, the material thus furnished gives us the same movements as camphor when placed on the surface of water.

But such a substance *is* furnished in the form of "collodion," or the solution of "Pyroxylin," or dinitro-cellulose in a mixture of ether and alcohol. And if a drop of collodion be placed gently on the surface of water, the movements which it displays are very nearly identical with those of lighted camphor. And it is found that other materials of a like nature are capable of giving rise to motions on the surface of water.

Thus, if solid materials are painted or coated with benzol, turpentine, colza, and essential oils they go through movements somewhat like those of camphor on water; but of all these the drop of collodion gives the best results.

The E.C. Powder Works,
Green Street Green, near Dartford.

Pollution of Streams.—It is remarked that kieserite, and especially magnesium chloride, if it finds its way into streams, renders the water deadly to fish and dangerous for economic and alimentary uses.—*Journ. de Pharm.*

A CATALOGUE OF CHEMICAL PERIODICALS.*

By H. CARRINGTON BOLTON, Ph.D.,
Professor of Chemistry in Trinity College, Hartford, Conn.

(Continued from p. 267).

EXPLANATION OF SIGNS.

+ Following a date signifies current at the date in question.
|| Following a date signifies publication discontinued.

54. CHEMICAL (THE) RECORD AED DRUG PRICE CURRENT. 1 vol., 4to. London, 1851, 52.||

55. CHEMICAL (THE) REVIEW. A monthly journal for manufacturing chemists and druggists, dyers, printers, bleachers, sizers, paper-makers and stainers, leather-dressers, &c. 14 (?) vols., 4to. London, 1871-'84.+

56. CHEMICAL REVIEW and Journal for the Spirit, Vinegar, and Sugar Industry. Published by J. E. Siebel. 1 vol., 4to. Chicago, 1881.

Continued under the title;

[a] American Chemical Review and Journal for the Spirit, Vinegar, and Sugar Industry. Devoted to the interests of the arts of applied chemistry. 3 vols., 4to. Chicago, 1882-'84.+

CHEMICAL (THE) TIMES AND JOURNAL OF PHARMACY.
See Pharmaceutical Times.

57. CHEMIKER-KALENDER. Herausgegeben von Rudolph Biedermann. 5 vols., 16mo. Berlin, 1880-84.

Accompanied by a second part, entitled:

[a] Technisch-chemisches Jahrbuch. Herausgegeben von Rudolph Biedermann. 5 vols., 16mo. Berlin, 1880-'84.

CHEMIKER-ZEITUNG.
See Allgemeine Chemiker-Zeitung.

58. CHEMISCHE (DER) ACKERSMANN, Naturkundliches Zeitblatt für deutsche Landwirthe, herausgegeben von J. Adolph Stöckhardt. 21 vols., 8vo. Leipzig, 1855-'75.||

59. CHEMISCHE ANNALEN FÜR DIE FREUNDE DER NATURLEHRE, Arzneigelahrtheit, Haushaltungskunst und Manufacturen von Lorenz Crell. 40 vols. (2 vols. *per annum, not numbered*), 8vo. Helmstädt und Leipzig, 1794-1803.

Accompanied by:

Beiträge zu den chemischen Annalen von Lorenz Crell. 6 vols., 8vo. Leipzig und Dessau, 1785-'99. Vol. I., 1785, '86; II., 1787; III., 1788; IV., 1789; V., 1794; VI., 1899.

Vol. IV. *also under the title:* Beiträge zur Erweiterung der Chemie.

Cf. Chemisches Archiv; *also* Chemisches Journal.

60. CHEMISCHE (DIE) INDUSTRIE. Monatsschrift, herausgegeben vom Verein zur Wahrung der Interessen der chemischen Industrie Deutschlands. Redacteur: Emil Jacobsen. 7 vols., 4to. Berlin, 1878-'84.+

61. CHEMISCHE EN PHIJSISCHE OEFENINGEN VOOR DE BEMINNAARS DER SCHEI- EN NATUURKUNDE. Door P. J. Kastelyn, vervolgt door Bondt en J. R. Deiman. 3 vols. Amsterdam en Leyden, 1788.

Followed by:

[a] Nieuwe chemische en phijsische oefeningen. 1 part, 8vo. 1797.

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* Advance-proofs from the *Annals of the New York Academy of Sciences.*

INFLUENCE OF BILE, BILE SALTS, AND BILE ACIDS ON AMYLOLYTIC AND PROTEOLYTIC ACTION.[*]

By R. H. CHITTENDEN and GEO. W. CUMMINS.

(Concluded from p. 267).

3. *The Proteolytic Action of Trypsin in Neutral, Alkaline, and Acid Solutions.*

THE trypsin solution was prepared according to Kühne's method,[†] from dried pancreas freed from fat; the solution after neutralisation always contained some sodium salicylate, sufficient to prevent putrefaction during short digestive periods. According to Kühne,[‡] trypsin acts quite energetically, both in neutral and salicylic acid solutions, but most energetically when the pancreatic solution contains 0·3 per cent sodium carbonate. According to Heidenhain[‖] the action of definite percentages of sodium carbonate varies with the amount of ferment.

We have tried quantitative experiments, as a preliminary to studying the influence of bile, with the following results;[§] the mixtures were warmed at 40° C. for three hours and 40 minutes, and contained 2 per cent of fibrin :—

Reaction of the fluid.	Weight of undigested residue.	Fibrin digested.
Neutral	0·2312 grm.	76·88 p.c.
0·1 per cent Na_2CO_3	0·1570 ,,	84·30 ,,
0·2	0·0925 ,,	90·75 ,,
0·3	0·0772 ,,	92·28 ,,
0·4	0·0426 ,,	95·74 ,,
0·5	0·1038 ,,	89·62 ,,
0·1 p.c. salicylic acid	0·5651 ,,	43·49 ,,

With a larger percentage of fibrin and a longer period of digestion the results are somewhat different. The following were obtained with 4 per cent fibrin in six hours and forty minutes at 40° C. :—

Reaction of the fluid.	Weight of undigested residue.	Fibrin digested.
Neutral	0·3785 grm.	62·15 p.c.
0·1 per cent Na_2CO_3	0·2581 ,,	74·19 ,,
0·2	0·1395 ,,	86·05 ,,
0·3	0·1588 ,,	84·12 ,,
0·4	0·1629 ,,	83·71 ,,
0·5	0·1318 ,,	86·82 ,,
0·1 p.c. salicylic acid	0·4728 ,,	52·72 ,,

An average of the two series of results plainly shows that there is but little difference in digestive action in the presence of 0·2 to 0·5 per cent sodium carbonate, although in a given solution a change in the percentage of alkali is at once manifest, to a slight extent, in the amount of fibrin digested. Greatly increased percentages of alkaline carbonate materially diminish the action of the ferment, as the following series of experiments indicate; the mixtures were warmed for two hours at 40° C. :—

Reaction of the fluid.	Weight of undigested residne.	Fibrin digested.
Neutral	0·5863 grm.	41·37 p.c.
0·5 per cent Na_2CO_3	0·1584 ,,	84·16 ,,
1·0	0·3760 ,,	62·40 ,,
2·0	0·7010 ,,	29·90 ,,
3·0	0·7892 ,,	21·08 ,,
4·0	0·8373 ,,	16·27 ,,
5·0	0·8608 ,,	13·92 ,,

The difference in action between a neutral trypsin solution and a solution containing salicylic acid is quite noticeable; at the same time it is evident that in the acid-reacting fluid the trypsin simply acts more slowly, and if time be given, the action will approach more closely to that of the neutral solution. It is of course understood that the salicylic acid in the above experiments does not exist in the free state, but in combination with the proteid matter present, and doubtless in most of the experiments recorded, where trypsin has been exposed to the action of small fractions of a per cent of acid, no free acid has been present, but only varying percentages of acid-proteids.[*] Kühne[†] has pointed out that hydrochloric acid above 0·05 per cent is injurious to the action of trypsin, and Heidenhain[‡] has shown that the addition of 0·1 per cent hydrochloric acid to an aqueous extract of the pancreas stops its action. C. A. Ewald,[‖] however, found that while pepsin-hydrochloric acid destroyed trypsin, trypsin could digest fibrin in the presence of 0·3 per cent hydrochloric acid. Mays[§] likewise found that trypsin digestion could take place in the presence of 0·3 per cent hydrochloric acid, but only when a relatively large proportion of fibrin was present, and in corroboration of Kühne's statement, he showed that trypsin could be destroyed both by pepsin and dilute hydrochloric acid. Engesser[¶] found that a pancreatic juice did not lose its tryptic power by two hours' warming with a gastric juice containing 0·5 per cent hydrochloric acid. Langley,[**] on the contrary, has shown that a glycerin extract of the pancreas loses a very appreciable amount of trypsin when warmed for two and a half hours with 0·05 per cent hydrochloric acid. Lindberger,[††] working with an alcoholic precipitate from a glycerin extract of ox pancreas, in which there would naturally be present but a small amount of proteid matter in addition to the trypsin, found that in the presence of 0·1 per cent hydrochloric acid the ferment was entirely without action, and even in the presence of 0·012 per cent hydrochloric acid, fibrin was much more slowly dissolved than by a neutral trypsin solution. Lindberger, moreover, found that weaker acids, as acetic and lactic, had a much different effect than the stronger hydrochloric acid; thus, with dilute acetic acid digestion of the fibrin was almost as rapid as with a neutral solution of trypsin, while with small amounts of lactic acid the ferment action was even more energetic than in a neutral solution. There is, however, no guarantee that in these experiments free acid was present.[‡‡]

We have found that *free* acids, even when present in small percentages, completely stop the proteolytic action of trypsin, and that when considerable albuminous matter is present, the action of trypsin is much hindered by the addition of acid to a neutral solution, even before the proteid matters present are saturated with acid. 0·1 per cent *free* salicylic acid, in the presence of proteids already saturated with the acid, allows no proteolytic action whatever. On the other hand, a sufficient amount of proteid matter just saturated with hydrochloric acid, no free acid being present, will almost completely stop the action of trypsin. Proteid matter, however, only partially saturated with acid has a much smaller retarding action. This, doubtless was the condition of the mixtures in May's and Engesser's experiments above referred to, for, as May states, the ferment could act in the presence of 0·3 per cent hydrochloric acid only when a relatively large proportion of fibrin was present.

A pancreatic juice prepared from 20 grms. of dried pancreas by warming it at 40° C. with 200 c.c. 0·1 per cent salicylic acid, &c , was finally made exactly neutral and diluted to 500 c.c.; 25 c.c. of this solution required 7·5 c.c. of a 2·0 per cent solution of salicylic acid to com-

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[*] Reprinted from *American Chemical Journal*, vol. vii., No. 1.

[†] *Untersuchungen aus der physiolog. Inst. p. Universität Heidelberg*, i., 222.

[‡] *Ibid* , p. 223.

[‖] *Pfluger's Archiv.*, x., 576.

[§] The pancreatic juice was prepared from 20 grms. dry pancreas, and finally diluted to 1000 c.c. 50 c.c. were used in each digestion with 1 grm. of pure fibrin.

[*] See Danilewsky. *Centralbl. med. Wiss.*, 1880.

[†] *Vehr. Naturhist., med. Vereins zu Heidelberg*, 1877, p. 193.

[‡] *Pflüger's Archiv* x., 578.

[‖] *Jahresbericht für Thierchemie*, 1880. p. 297.

[§] *Untersuch a. d. physiolog. Inst. d. Univ. Heidelberg*, iii., 378, 1880.

[¶] *Jahresbericht für Thierchemie*, 1880, p. 297.

[**] *Journal of Physiology*, vol. iii., No. 3.

[††] *Jahresbericht für Thierchemie*, 1883, p. 281.

[‡‡] We have only seen the abstract of Lindberger's paper, so cannot speak positlvely on this point.

pletely saturate the proteids present,* the excess of free acid necessary to give the tropæolin reaction being deducted.

Three digestive mixtures were made as follows:—

1. 25 c.c. of the neutral pancreatic solution + 50 c.c. water.

2. 25 c.c. of the same pancreatic solution + 7·5 c.c. 2·0 per cent salicylic acid solution + 17·5 c.c. water. The mixture was acid to test-papers, but gave no reaction with tropæolin. It therefore contained no free acid, but 0·3 per cent of combined acid.

3. The same as No. 2, but 2·5 c.c. more of 2·0 per cent salicylic acid, so that the solution contained, in addition to the acid proteids, 0·1 per cent free salicylic acid.

1 grm. of fibrin was added to each of these and the mixtures warmed at 40° C. for eight hours and forty minutes. No. 1 digested 88·34 per cent of the fibrin, No. 2 13·44 per cent, while No. 3 had no action whatever.

Much smaller percentages of combined salicylic acid cause an equally diminished proteolytic action; thus, in the case of a carefully dialysed juice where the proteid matter was much diminished, the digestive mixture, with its proteids wholly saturated, contained but 0·060 per cent of combined salicylic acid; yet this mixture, in 15 hours at 40° C., digested but 17·10 per cent of fibrin, while the same amount of the neutral trypsin solution digested 57·80 per cent. Combined hydrochloric acid has a greater hindering action than salicylic acid, as the following results show:—

Pancreatic solution of trypsin.	Fibrin digested in 18 hours.
Neutral	57·80 p.c.
0·034 p.c. combined HCl + no free HCl	3·90 ,,
0·034 ,, ,, HCl + 0·005 p.c. HCl	2·31 ,,
0·034 ,, ,, HCl + 0·010	0·87 ,,

It is thus evident that in an ordinary digestive mixture, or even where albuminous matter is present only in limited quantity, the addition of hydrochloric or salicylic acid to a neutral solution of trypsin reduces its proteolytic action to a minimum before any free acid is present.

4. *Influence of Bile, Bile Salts, and Bile Acids on the Proteolytic Action of Trypsin.*

The addition of bile to a *neutral* pancreatic juice causes but little change in its proteolytic action, as is seen from the following results obtained with ox bile containing 8·3 per cent solid matter:—

Bile.	Weight of undigested fibrin.	Fibrin digested.
0 per cent.	0·4118 grm.	59·82 per cent.
1·0 ,,	0·3907 ,,	60·93 ,,
10·0 ,,	0·3938 ,,	60·62 ,,

A slightly increased action is the only effect produced on the trypsin.† The addition of bile to an *alkaline* pancreatic juice does not produce any very different results. The following were obtained with a pancreatic juice containing 0·3 per cent sodium carbonate and fresh ox bile containing 10·02 per cent solid matter:—

Bile.	Weight of undigested residue.	Fibrin digested.
0 per cent.	0·3056 grm.	69·44 per cent.
0·25 ,,	0·3074 ,,	69·26 ,,
0·50 ,,	0·3488 ,,	65·12 ,,
1·00 ,,	0·3633 ,,	63·67 ,,
5·00 ,,	0·3278 ,,	67·22 ,,
10·00 ,,	0·3603 ,,	63·97 ,,

Here there is no increased proteolytic action, neither is there any very great retarding effect produced. Pure sodium glycocholate and taurocholate produce results similar to bile, as the following table shows. The pancreatic juice contained 0·3 per cent sodium carbonate:—

Sodium taurocholate.	Weight of undigested residue.	Fibrin digested.
0 per cent.	0·2308 grm.	76·92 per cent.
0·05 ,,	0·2566 ,,	74·34 ,,
0·10 ,,	0·3048 ,,	69·52 ,,
1·00 ,,	0·2832 ,,	71·68 ,,
Sodium glycocholate.		
0·10 per cent.	0·2576 grm.	74·24 per cent.
0·20 ,,	0·3154 ,,	68·46 ,,

The presence of 3·0 per cent crystallised ox bile caused a somewhat different result, increasing the proteolytic action slightly; thus, while the control, containing 0·3 per cent sodium carbonate, digested 88·69 per cent fibrin, the same trypsin solution plus 3 per cent of crystallised bile digested in the same time 89·73 per cent fibrin.

While bile or bile salts have but little influence on the proteolytic action of trypsin, the bile acids, even small percentages, have a much more marked effect. The following results, obtained by the addition of the bile acids to a neutral pancreatic juice, show the extent of the action:—

Bile acids.	Weight of undigested residue.	Fibrin digested.
0	0·2516 grm.	74·84 per cent.
Glycocholic, 0·03 per cent.	0·1993 ,,	80·07 ,,
Taurocholic, 0·10 ,,	0·3455 ,,	65·45 ,,
0·20 ,,	0·4332 ,,	56·68 ,,
0·50 ,,	0·4170 ,,	58·30 ,,

Here, the retarding influence of taurocholic acid is very manifest, while, on the other hand, the small percentage of glycocholic acid appears to increase the action of the ferment.

In view of the possible acid-reacting character of the contents of the small intestines, it becomes an interesting point to ascertain the influence of bile on the action of trypsin in the presence of more or less combined acid. With a pancreatic juice in which the proteids were partially saturated with salicylic acid, 0·1 per cent combined acid being present, the following results were obtained:—

Bile.	Weight of undigested fibrin.	Fibrin digested.
0 per cent.	0·4822 grm.	51·78 per cent.
1·0 ,,	0·4858 ,,	51·42 ,,
10·0 ,,	0·4091 ,,	59·09 ,,

This increased action in the presence of 10 per cent of bile accords with Lindberger's results, this experimenter having found that bile in the presence of small percentages of (combined?) acetic and lactic acids tends to diminish the retarding effect produced by the acids alone.

In the presence of combined hydrochloric acid, the bile salts produced no effects whatever; the trypsin was entirely without action.

Separation of Copper and Cadmium.—A. Béhal.—On adding to a mixture of copper and cadmium salts a very alkaline solution of sodium tartrate there is formed no precipitate, or at most a slight turbidity, which disappears on agitation. If the liquid is heated to a boil all the cadmium oxide is precipitated, and the copper remains in solution. The white precipitate of cadmium oxide deposits rapidly; it is placed on a filter, washed with a few drops of distilled water, washed, and re-dissolved in ammonia. The ammoniacal solution gives a pure yellow precipitate with ammonia hydrosulphate. Ammoniacal salts prevent for a time the formation of a precipitate. In this case the solution of the tartrate of the two salts is boiled with a slight excess of alkali. The ammonia is driven off and the precipitates forms.—*Journ. de Pharm* vol. xi., No. 10.

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* Tested by tropæolin OO according to the method of Danilewsky (*Centralbl. med. Wiss.*, 1880). One drop of a solution containing 0·028 per cent free salicylic acid gives a reddish violet colour, which is, however, not permanent as in the case of hydrochloric acid, but transient. With hydrochloric acid, one drop of a 0·003 per cent solution will give the reaction.

† Compare Heidenhain, *Pflüger's Archiv.*, x., 579.

PROCEEDINGS OF SOCIETIES.

CHEMICAL SOCIETY.

Thursday, June 4th, 1885.

Dr. H. Müller, F.R.S., President, in the Chair.

Mr. Harold Follows was formally admitted as a Fellow of the Society.

Certificates were read for the first time in favour of Messrs. Gibson Dyson, 231, Wilton Terrace, Manchester; William Herbert Hyatt, 9, Margravine Gardens, West Kensington, W.; Gerald Martin, Imperial Mint, Bombay; Thomas J. Menzies, M.A., 211, Crown Street, Glasgow; John Dominie Vieira, Rio de Janeiro; Herman J. Vueté, 79E, 111th Street, New York; Arthur Benjamin Winstone, 53, Russell Square, W.C.; T. G. Wormley, Philadelphia; James C. Wright, 14, Hill Street, Irvine, N.B.

The following were elected Fellows of the Society:—Messrs. Joseph Fearon Burnett, Thomas J. Greenway, Alfred Daniel Hall, T. Vaughan Hughes, Duncan Scott Macnair, Francis George Newbold, Thomas Goddard Nicholson, William Hugh Spottiswoode, Charles Johnson Taylor, Robert Wallace.

The following paper was read:—

48. "*On the Constitution of the Haloid Derivatives of Naphthalene.*" By Prof. Meldola.

The starting-point of the present research is a new bromonitro-α-acenaphthalide (m. p. 225°) obtained by adding bromine to a cold acetic acid solution of Liebermann's mixture of nitracenaphthalides; under these circumstances the paranitracenaphthalide is alone attacked. The bromonitracenaphthalide thus produced furnishes a new bromonitronaphthylamine on hydrolysis (m. p. 127°; $NH_2:Br:NO_2=1:2:4$), and by the action of aqueous caustic alkalies it is converted into a corresponding bromonitronaphthol (m. p. 146°), of which several metallic derivatives have been prepared and analysed.

The author has incidentally prepared Liebermann's γ-nitracenaphthalide in a state of purity; it melts at 117°. All the derivatives which have hitherto been obtained from it are identical with those produced from paranitracenaphthalide, and it is not improbable that the γ-modification is a physical isomeride of the para compound; the author finds, however, that the γ-compound is less readily acted upon by bromine than ordinary paranitracenaphthalide.

The constitution of Liebermann's nitrobromonaphthylamine (from bromacenaphthalide) has been established by reducing its acetyl-derivative, which is found to yield an "anhydro-base."

Two nitrobromonaphthalenes have been prepared from the two nitrobromonaphthylamines (Liebermann's and the author's); they do not differ in appearance or melting-point (131° to 132°), although from the manner in which they are formed it must be concluded that in the one $NO_2:Br=2:4$, and that in the other $Br:NO_2=2:4$, a view which is confirmed by the fact that both furnish the same metadibromonaphthalene (m. p. 64°) when the NO_2 radicle is displaced by bromine.

These two nitrobromonaphthalenes are readily reduced by adding zinc-dust to a solution in cold acetic acid. The resulting bromonaphthylamin in which $NH_2:Br=2:4$ melts at 71·5°, and that in which $Br:NH_2=2:4$ melts at 62°; their acetyl derivatives have practically the same melting-point, viz., 186·5° to 187°.

Another atom of bromine is readily introduced into each of these bromacenaphthalides, but in both cases enters the "unsubstituted benzene ring," taking up an α-position in that in which the acetamido group is in the α-position, and a β-position in that in which the $NH.\overline{Ac}$ group is in the β-position. The dibromacenaphthalides melt at about the same temperature (221° to 222°); the corresponding dibromonaphthylamines melt respectively at 101° to 102° (the α-NH_2 mod.) and 105° (the β-NH_2 mod.), and both furnish the same dibromonaphthalene (m. p. 74°), when the NH_2 radicle is displaced by hydrogen. There are two formulæ possible for each modification which are compatible with the facts, but the more probable formulæ of the dibromonaphthylamines are, according to the author,—

$NH_2 : Br : Br = 1 : 3 - 1'$ (m. p. 101° to 102°)
$NH_2 : Br : Br = 2 : 4 - 2'$ (m. p. 105°),

the constitution of the dibromonaphthalene from them being probably $Br : Br = 1 - 3.'$

The tribromonaphthalenes corresponding to the two dibromonaphthylamines have been prepared, and probably contain the bromine atoms in the relative positions $1 : 3 - 1'$ (m. p. 105°), and $2 : 4 - 2'$ (m. p. 110°).

The next part of the paper deals with the iodine-derivatives of naphthalene, of which the two moniodonaphthalenes have up to the present time been the sole representatives. The mixture of nitracenaphthalides obtained by nitrating a solution of α-acenaphthalide in acetic acid was converted by the action of alcoholic potash into a mixture of the corresponding nitronaphthylamines; the latter were then diazotised and converted into the corresponding nitroiodonaphthalenes by the action of iodhydric acid. By fractional crystallisation from alcohol, two modifications were isolated in a state of purity, the chief product being the para-modification (α-nitriodonaphthalene, $I:NO_2=1:4$, m. p. 123°), and the other the ortho-compound (β-nitriodonaphthalene, $I:NO_2=1:2$, m. p. 108·5°). A third (γ) nitriodonaphthalene, ($NO_2:I=1:2$, m.p. 88.5°) has been obtained by hydrolysing Jacobsen's nitracenaphthalide (*Ber.*, xiv., 805) and displacing the NH_2 group by iodine as before.

β-Nitriodonaphthalene cannot be reduced without the iodine-atom becoming displaced, and it then furnishes β-naphthylamine. The α- and γ-modifications can be converted by reduction with zinc-dust in cold acetic acid solution into the corresponding iodonaphthylamines, but owing to their instability these bases have not yet been isolated. By immediately diazotising and decomposing with hydriodic acid, however, the two iodonaphthylamines may be converted into the corresponding di-iodonaphthalenes; the 1 : 4 modification melts at 109° to 110°, and the 1 : 2 di-iodonaphthalene melts at 81°.

By displacing the NH_2 group in the bromonaphthylamines by iodine, three bromiodonapththalenes have been obtained, viz., $Br:I=1:4$ (m. p. 83·5), $Br:I=1:2$ (m. p. 94°), and $Br:I=1:3$ (m. p. 68°).

Neither α- nor β-acenaphthalide can be directly iodised, but α-iodacenaphthalide (m. p. 196°) has been prepared by reducing α-nitroiodonaphthalene (m. p. 123°) and acetylating the product by cohobation with acetic anhydride. This iodacenaphthalide (m. p. 235° to 236°) furnishes a nitro-compound which is converted by the action of caustic potash into nitriodonaphthol, $HO:NO_2:I=1:2:4$, m. p. 145° to 146°).

Iodobetanaphthol has been prepared by treating a solution of betanaphthol in glacial acetic acid with iodine in the presence of lead acetate, and anhydrous sodium acetate dissolved in the same solution. It crystallises in white needles melting at 97°, and is soluble in very dilute alkalies.

Discussion.

Dr. Armstrong said that it was not only in passing from the di- to the tri-derivatives of naphthalene that the law of substitution was no longer the same as for benzene derivatives; the beta-mono-derivatives of naphthalene exhibited marked peculiarities, attack being as a rule shifted "to the other ring" whenever a negative radicle was present in the β position, as in the case of betanaphthol, for example. This was also observed in the formation of disulphonic acids from naphthalene. In these cases it was probable that the radicle took up such a position in the previously unoccupied "ring" that the compound having what might be regarded as the more symmetrical of the two possible symmetrical formulæ was produced: on this account he was inclined to take the opposite view to Prof. Meldola regarding the formulæ of the dibromonaphthylamines.

Mr. Groves remarked that Prof. Meldola had, he thought, introduced a great improvement in the method of iodising, by operating in presence of a lead salt. The use of mercuric oxide was objectionable on account of the solubility of mercuric iodide in almost everything; it was, in fact, only possible to get rid of it by displacing the mercury by some other metal.

At the next meeting, on June 18th, the following papers will be read:—

"The Decomposition and Genesis of Hydrocarbons at High Temperatures. The Products of the Manufacture of Gas from Petroleum." By Drs. Armstrong and A. K. Miller.

"The Non-Crystallisable Products of the Action of Diastase upon Starch." By Horace T. Brown and G. H. Morris, Ph.D.

"On the Decomposition of CO_2 at High Temperatures." By H. B. Dixon.

"On the Influence of Silicon upon the Properties of Cast-Iron." By T. Turner.

NOTICES OF BOOKS.

Manual of Chemistry: a Guide to Lectures and Laboratory Work for Beginners in Chemistry. Text-book specially adapted for Students of Pharmacy and Medicine. By W. Simon, Ph.D., M.D., Professor of Chemistry and Toxicology in the College of Physicians and Surgeons; Professor of Chemistry and Analytical Chemistry in the Maryland College of Pharmacy, Baltimore. London: Baillierè, Tindall, and Cox.

This book, in respect to extent, takes a middle position between the standard works of reference and the little manuals and *vade mecums* which have for some years appeared in such surprising numbers. Unlike the majority of the latter it contains no reference to any examination or "syllabus," and is written with the good old-fashioned purpose of enabling the student to "know" his subject. Being intended mainly for medical and pharmaceutical students, special attention is given to such elements and compounds as are used medicinally, and the leading principles of physiological chemistry are given in outline. Dr. Simon has retained the somewhat antiquated classifications of the elements into metals and non-metals, and of compounds as organic and inorganic, in the belief that such an arrangement is the best adapted for the instruction of beginners. Very many elements are omitted, those, namely, which are not employed in medicine and which play no obvious part in the economy of nature.

As an interesting and novel feature we must call attention to the coloured plates representing chemical reactions. We call this feature novel, for, although from Runge's *Farbenchemie* downwards, works dealing with the applications of chemistry to the tinctorial arts have been illustrated in a manner somewhat similar, yet, to the best of our knowledge, no attempt has been made, in treatises on general chemistry, to give a clearer idea of coloured reactions than can be conveyed in words. How vague is such verbal information, except where it refers the reader to some well-known accessible object for comparison, there is no need to explain. In case of coloured precipitates a portion of the actual substance is given cemented upon a slip of paper and pasted down to the plate, giving not merely the actual colour, but to some extent the texture, of the precipitate as it appears in the dry state. Where the result of a reaction is not a precipitate but a change in the colour of a solution, often of a fugitive nature, this method is, of course, impracticable. In such cases slips of paper have been coloured with suitable pigments or dyes, so as to reproduce the tints actually manifested in the solutions. In this manner are represented the murexide test for uric acid, Fehling's sugar-test, Böttger's bismuth sugar-test, Gmelin's test for biliary pigments, Pettenkofer's test for the biliary acids, morphine with ferric chloride and with nitric acid, codeine with the sulpho-molybdic test, quinine with chlorine-water and ammonia, strychnine with sulphuric acid and potassium dichromate, brucine dissolved in nitric acid and treated with stannous chloride, atropine with sulphuric acid and potassium dichromate, and veratrine with sulphuric acid. It is no easy task to reproduce accurately upon paper the exact shade of colour displayed by the contents of a test-tube, but it has here been effected with success, some of the tones being, if anything, a trifle too bright. It is obvious that this method of illustration must be costly and laborious, and that the books must be carefully handled, and above all things be preserved from sulphur fumes. But as giving standards of reference for the student who has just obtained some reaction these colour-plates must be invaluable.

We notice that although this work is published in London it must, judging from the system of orthography adopted, have been printed in the United States.

The Specialists' Series. Edited by Dr. Paget Higgs. Vol. III.—*Ballooning: a Concise Sketch of its History and Principles.* From the best sources, Continental and English. By G. May. London: Symons and Co.

"If all mankind were good and virtuous," says an inventor in Rasselas, "I would with great alacrity teach them to fly." Our modern inventors, it seems, have no such scruples. In the little treatise before us the idea is never mooted that balloons capable of being steered, whatever else they might effect, could not fail to offer new facilities for aggressive war, for that class of outrages now known as private war, and for brigandage. At present we have no need to fortify the upper windows, sky-lights, or roofs of our banks, warehouses, or mansions. But if "aërostats" ever come into ordinary use we shall have the enterprising burglar sailing right over the head of the policeman, effecting an entrance from above, or from some inner court hitherto quite inaccessible, and departing leaving no clue behind which should throw suspicion upon any one inhabitant of our globe more than upon any other.

Mr. May admits that the results of the tragic ascent of Spinelli, Sivel, and Gaston Tissandier, "in a scientific point of view, are almost nil." He asks if we can hope for better results from ascents to great heights, and answers his question in the negative. We are reminded of the narrow escape of Messrs. Glaisher and Coxwell, and the causes are pointed out which render scientific observations difficult and untrustworthy. Men paralysed with cold, enfeebled by respiring an attenuated atmosphere, and tormented by the irritation due to an abnormal electrical tension (p. 44) are not likely to arrive at very valuable results. The chief value of flying-machines, if they could be steered and adapted to long distances, would be for the exploration of unhealthy or otherwise dangerous or trackless districts. To map out the northern or southern polar regions, or the untrodden portions of central Africa, whilst gliding over them through the air is a tempting prospect for the geographer.

An English writer—not named—is quoted as saying:—"It is not impossible that by means of a propeller worked by *adequate* power supplemented by sails which can be adjusted at varying angles, a balloon may be guided to a certain extent on an aërial sea, but it must be confessed that at present no one has succeeded in doing so."

As regards the probable cost, in other words "the relation between the means and the results obtainable," the author is necessarily uncertain, but far from sanguine. If we might advise we should recommend inventors to turn their attentions where success, if attained, will show a larger balance of benefits as compared with evils.

Proceedings of the American Pharmaceutical Association at the Thirty-second Annual Meeting, held at Milwaukee, Wisconsin, August, 1884. Philadelphia: American Pharmaceutical Association.

At the very outset of this volume we find a list of questions proposed to be answered at the thirty-third meeting of the Association. Here we find an inquiry for "a good process for determining tannic acid." This is tantamount to an avowal that no one of the existing methods—and they are not few—is fully satisfactory. There is also demanded a paper on "the tests for brucine in the presence of strychnine, and for strychnine in presence of brucine;" also a plan for the perfect separation of the alkaloids. Whether this refers merely to the two alkaloids—brucine or strychnine—or to the alkaloids in general, is not distinctly stated. There is also a demand for "the best practical method to determine melting-points."

Under the heading "Pharmacy" we find a profusely illustrated section on apparatus and manipulations, not a few of which have no special connection with pharmacy.

The uncertainty of the permanganate test for nitrates is pointed out, the results, when carried out with care, showing deficiencies of 15·5 to 16 per cent. We find, taken from the *American Druggist*, a method for determining nitric acid in water which is not generally known. A strip of zinc, which has been coated with copper, by immersion in a 3 per cent solution of copper sulphate is placed in the liquid under examination. Any nitric acid present is converted into ammonia, which is thrown down by mercuric chloride as mercury amido-chloride. If the water contains ammonia also, this must be determined by a separate operation.

According to Beckurts, the statement of Schwanert that lead-salts prevent the luminosity of phosphorus in Mitscherlich's apparatus is inaccurate.

According to investigations made in the Bavarian Gewerbe Museum phosphorous acid is the best agent known for bleaching bones, the fat having been previously removed by the usual solvents.

As boracic acid has been of late recommended as a harmless disinfectant, it is important to note the two fatal cases here quoted from the *Louisville Med. News* and the *Medical Record* as having resulted from its use.

Concerning the probable, or possible, effects of tin entering into solution in tinned foods, we find conflicting statements. An investigation has been made as to the cause of the offensive breath of persons who have taken bismuth medicinally. This phenomenon has been traced to the presence, as an impurity, of traces of tellurium. It is well known that small doses of tellurous oxide communicate a garlic odour to the secretions and excretions. The author, Mr. W. Reisert, seems to have experimented upon himself, and after taking 0·015 grm. of tellurous oxide found the peculiar odour remaining in the urine for 382 hours, in the sweat for 452 hours, in the fæces for 79 days, and in the breath for 237 days.

Viewed as a whole, the section on the "Progress of Pharmacy," though rich in valuable matter, stands in need of dissociation, not a few of the extracts given having no visible connection with pharmacy at all.

The tendency of legislation concerning the sale of poisons seems in some of the States likely to interfere with scientific research. Thus, at Milwaukee, we find the mineral acids scheduled as "poisons." Surely this squeamishness, when there are no corresponding restrictions on the sale of ammunition and explosives, is, to say the least, somewhat inconsistent.

Le Manganese. Son Role dans la Vie de l'Homme. Memoire presenté à l'Académie des Sciences. Par E. J. Maumené. Paris: Cosmos Office. (Manganese; its part in Human Life. A Memoir presented to the Academy of Sciences.)

In this memoir the author demonstrates the presence of manganese in the greater part of the plants used as food by man and by the lower animals. Among these we find wheat, potatoes, rye, rice, barley, lentils, peas, most fruits, cocoa, coffee, and especially tea. In lemons and oranges manganese is absent, as well as in all the plants containing sulphur-compounds.

Although manganese is thus constantly introduced into the system it cannot be detected in the blood. It occurs in doubtful traces in the urine and the bones, and it is constantly found in the suint of sheep. In the solid excrements it is invariably present, its elimination being effected by this channel. As it is not assimilated and retained in the human system it forms to some extent a negative standard for judging of the value of alimentary matters. From an experiment on the blood of an ox the author surmises that in some animals manganese may be retained longer than in man, and that we may find herein an additional means for distinguishing human blood from that of cattle.

M. Maumené suggests that the medical use of manganese as an adjunct to, or substitute for, iron should be abandoned.

In determining the mineral constituents of the ash of plants, the author recommends that the incineration should be effected at high temperatures, and with the addition of a little potassium carbonate.

The Applicability of Ductile Nickel in Chemical Laboratories. By Prof. Fr. Stolba. Prag: Royal Bohemian Society of Sciences. (Die Anwendbarkeit des dehnbaren Nickels in den chemischen Laboratorien.)

This pamphlet is intended to call attention to the valuable properties of metallic nickel when so far purified as to be malleable and ductile. It does not rust, and is very permanent when ignited. It is fusible only at a very strong white heat. It is exceedingly little attacked by melting nitrates and alkaline hydrates, and renders these agents much more generally applicable than heretofore in opening up refractory minerals. The author has opened up in this manner twenty successive samples of zircon in succession, in one and the same nickel crucible, without wearing it out. Nickel is especially recommended for capsules, crucibles, muffles, screens, spatulæ, forceps, and tongs, &c.

Care must be taken, however, not to bring apparatus of nickel into direct contact with ignited charcoal or coke, as they are thus rendered brittle, probably by combining with carbon, especially if the ignition is prolonged. Hence nickel crucibles require to be placed within a clay crucible if the heat of a charcoal or coke furnace is required. Nickel is also exceptionally liable to become coated with soot, even when in contact with flames which do not smoke and which burn without luminosity. Hence it is necessary to arrange gas-lamps and gas-furnaces so as to burn with the greatest possible supply of air.

CORRESPONDENCE.

COAL-TAR ANALYSES.

To the Editor of the Chemical News.

Sir,—As a good deal of interest attaches to tar analyses, and no two chemists seem to give their results with anything like uniformity (see Chemical News, vol. li., p. 254), I beg to suggest the following as suitable to get at the market value of the tar. If any one can suggest a better form perhaps you will permit him to do so.

Specific gravity..	
First stage—	
	Per cent.
Light oils	
Ammonia water	
Creosote oil	
Naphthalene	
Thick anthracene oil	
Pitch (sp. gr.)	
	100·00
Second stage—	
	Per cent of ammonia.
Ammonia water	
Third stage—	
Treatment of the Light Oils.	
	Per cent.
Benzole, boiling 80°—100° ..	
Toluol, boiling 100°—120° ..	
Solvent naphtha	
Burning naphtha	
Carbolic acid (crude)	
Loss	
	100·00

Remarks.

—I am, &c.,

Tar Distiller.

June 1, 1884.

SIR WILLIAM THOMSON'S MOLECULAR DYNAMICS.

To the Editor of the Chemical News.

Sir,—I shall be obliged if any of your readers can tell me where I can obtain a copy of the papyrograph report of Sir William Thomson's lectures on Molecular Dynamics delivered at Baltimore during October, 1884.—I am, &c.,

C.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

Note.—All degrees of temperature are Centigrade unless otherwise expressed.

Journal für Praktische Chemie.
Vol. xxxi., Parts 5 and 6.

The Determination of the Constants of Capillarity of certain Aqueous and Alcoholic Solutions by observing their Heights and Capillary Tubes.—J. Traube.—Not capable of useful abstraction.

Trustworthiness of the Determinations of Electric Resistances with Alternating Currents.—W. Ostwald.—The author finds that the values found with a constant current agree with those obtained with alternating currents.

Basicity of Hyposulphuric Acid.—H. Trey.—The author demonstrates the monobasic character of hyposulphuric acid, thus establishing the accuracy of Kolbe's conjecture made known eight years ago.

The Quantitative Determination of Asparagine and Glutamine.—E. Schulze.—A discussion of the precautions to be taken in carrying out the method of Sachsse.

Transit of Arsenious Acid from the Amorphous to the Crystalline Condition.—Clemens Winckler.—The opacity of vitreous, amorphous arsenic glass when heated, and its opacity on long preservation at ordinary temperatures, are two distinct phenomena. The one change pervades immediately the whole mass, and is not attended with the formation of crystals. The opacity which sets in on long keeping is very gradual, and consists in the transition from the amorphous, vitreous state to that of an accumulation of octadedral crystals. This change does not occur if the arsenious acid is preserved in a vacuum or in perfectly dry gases, such as air, hydrogen, and carbonic acid. The opacity is due to the presence of moisture, and increases the more rapidly the more water is present. The statement of Christison and H. Rose that the vitreous acid undergoes no change if preserved under water, and that of Rose that it is likewise permanent if kept in alcohol, could not be verified.

Contributions to the Chemistry of the Ammonio-Cobaltic Compounds.—S. M. Jörgensen.—In this chapter of his memoir the author describes the sulphate-purpureo-cobaltic salts.

Journal de Pharmacie et de Chemie.
Vol. xi, No. 9.

Two Mono-chloric Mono-bromic Camphors.—P. Cazeneuve.—This paper has been already noticed.

Chrysophanic Acid.—M. Petit.—A pharmaceutical paper.

Determination of Potassium Iodide.—P. Carles.—The author notices a statement recently made that the process of Personne as modified by himself gives results in excess of the truth. He points out the necessity of certain precautions. Thus the alcohol employed should be rectified to remove extractive matter derived from the wood of the casks and also aldehyds. Without this purification the mercurial solution becomes turbid, deposits calomel, becomes impoverished, and gives results too high.

Composition of Terpinol.—Ch. Tanret.—The formula of terpinol $(C_{20}H_{16})2H_2O_2$ should be rejected; the true terpinol boiling at 215° to 220° is a terebenthene monohydrate, and the product obtained by the action of dilute acids upon terpinol, or by that of alcoholic potash upon terebenthene dihydrochlorate, is merely a mixture of a carbide and of this monohydrate.

Preparation of Cyanogen in the Moist Way.—G. Jacquemin.—Already noticed.

Analysis of a Spring of Sulphated Ferruginous Mineral Water at Port Vendres.—Leon Ferrer.—Of purely local interest.

The Water Supply of Paris in 1881.—M. Couche.—Paris, without having the quantity of water which might be wished, is at present of all the cities of Europe the one where the public service is the least incomplete. Nowhere are dust and mud more efficiently combatted and the gutters more regularly washed out. As for the household service, Paris is now in the first rank as to the quality of the water distributed. The quantity per head is less by one-fifth than that of London, but the charges are more moderate.

No. 10.

The Absorption of Chlorine by Carbon and its Combination with Hydrogen.—MM. Berthelot and Guntz.—Already noticed.

New Case of Fraud with Preserved Foods.—P. Carles.—A sample of preserved tomatoes examined differed from a normal specimen by containing much less dry extract, potassium bitartrate, and total phosphoric acid. The author considered that the sample in question contained but little tomato, and was chiefly composed of carrots and pumpkins, the whole coloured with some aniline dye.

Action of Oxidisers upon Chloral Hydrate.—S. Cotton.—Already noticed.

Determination of Cyanogen mixed with Other Gases.—Georges Jacquemin.—To determine with a sufficient approximation the proportions of cyanogen, carbonic acid, oxygen, and nitrogen in a gaseous mixture, the author measures a volume of gas into a graduated jar over mercury. He introduces aniline, which absorbs the cyanogen. Then, without removing the aniline, he passes in a concentrated solution of potash to absorb the carbonic acid, and lastly a solution of pyrogallol, which, in presence of the excess of potash, absorbs the oxygen, leaving the nitrogen alone.

Zeitschrift für Analytische Chemie.
Vol. xxiv., Part 2, 1885.

Analysis of Vulcanised Caoutchouc, and especially the Determination of Sulphur therein.—B. Unger.—This paper will, if opportunity allows, be inserted in full.

Remarks on Mohr's Investigation on the Determination of Reverted Phosphoric Acid.—Prof. A. Petermann.—A critique on certain modifications in the writer's process proposed by Mohr. He shows that the direct treatment of the citrate solution with molybdic reagent is a quite unnecessary complication.

Determination of Phosphoric Acid.—C. Glaser.—The principle of the author's method rests upon the fact that phosphoric acid in presence of lime salts, &c., is directly precipitated by magnesia mixture with the application of ammonium citrate, provided that sufficient sulphuric acid is present to convert all the calcium salts into sulphates, and that not more ammonium citrate is used than may serve to retain all the calcium salts in alkaline solution. The following reagents are required:—1. Magnesia mixture, 140 grms.; magnesium sulphate, 150 grms.; ammonium sulphate and 30 grms. ammonium chloride are dissolved in 350 c.c. ammonia (16 per cent) and 1650 c.c. water, let stand for some days and filtered. 2. Solution of citric acid, 50 per cent. 3. Ammoniacal washing liquid; 250 c.c. ammonia at 16 per cent diluted to 1 litre. 4. Dilute sulphuric acid; 100 c.c. sulphuric acid at 66° are diluted to 1 litre. The solution containing the phosphoric acid is placed in a beaker, and ammonia is added until a turbidity just appears. Citric acid is then cautiously added by means of a dropping tube till the liquid becomes bright again. If it has then an alkaline reaction it is ready for precipitation. If it is still acid or neutral, ammonia or citric acid is alternately added until the point is reached, *i.e.*, until after adding the last drop of citric acid, the liquid has still a distinct alkaline reaction. The solution is then cooled, and the magnesia mixture is added drop by drop, stirring continually, and then a large excess of ammonia. After standing 6 or 8, or preferably 12 hours, it is filtered, washed with the dilute ammonia, the precipitate is dissolved on the filter with dilute sulphuric acid, and the phosphoric acid in the filtrate is re-precipitated with ammonia, with the addition of some magnesia mixture. As soon as the crystalline precipitate has settled it is filtered over asbestos in a platinum crucible with a sieve bottom by means of the air-pump, washed, ignited, and weighed.

Remarks on Carl Mohr's Memoir on the Determination of Reverted Phosphoric Acid in Dicalcium Phosphate.—C. Glaser.—Mohr remarks in his paper on this subject that "the method in this form is incapable of improvement." Glaser replies that phosphoric acid can certainly be completely thrown down from its solution in ammonium citrate if care is taken that sufficient sulphates are present,—an end ensured by the use of the magnesia mixture mentioned in the last paper.

Determination of Reverted Phosphoric Acid by the Oxalate Method as compared with the Modification of the Citrate Method recognised in the United States.—C Glaser.—Reverted phosphoric acid is here determined by digestion for half an hour with 100 c.c. solution of ammonium citrate, spec. grav. 1·09, at the constant temperature of 65°. The author works the oxalate method as follows:—After extracting the soluble phosphoric acid with the usual precautions the filter and the residue are placed in a covered beaker and boiled for 10 minutes with 100 c.c. of a solution of ammonium oxalate saturated in the cold, filtered, and washed with hot water. The filtrate is boiled with the addition of nitric acid, and the phosphoric acid is determined. The author finds that with dissolved phosphates containing but little iron this method gives good results. For natural guanos and iron phosphates a further modification is necessary.

A New Method for the Detection of Iodine, Bromine, and Chlorine.—E. Hart.—This paper requires the accompanying illustration.

Method for the Quantitative Separation of Chlorine and Bromine.—Dr. Emil Berglund.—This very important paper also cannot be intelligibly reproduced without the accompanying illustration.

Vortmann's Method for the Direct Determination of Chlorine in Presence of Bromine.—Dr. Emil Berglund.—Vortmann's method depends on the following alleged reactions:—A solution of a chloride in acetic acid at 2 or 3 per cent, mixed with lead peroxide, can be repeatedly evaporated to dryness without the loss of any chlorine; on the other hand, there is a distinct escape of chlorine if the strength of the acetic acid exceeds 5 per cent. If a bromide is mixed with lead peroxide and "dilute" acetic acid, bromine is liberated, and all the bromine can be expelled by repeated evaporation to dryness on the water-bath with fresh doses of acetic acid. Dr. Berglund finds the former statement correct, and the latter one also if the "dilute" acid has a strength of 10 per cent or upwards, but with acid of 2 or 3 per cent, such as does not attack chlorides, the assertion is, according to his experiments, incorrect. Hence the method cannot be regarded as satisfactory.

Determination of Nitrogen according to Kjeldahl.—E. Bosshard.—The author gives analyses of a number of pure nitrogenous compounds. The experimental results agree very closely with the proportion of nitrogen indicated by theory. He gives, however, the following caution:—Kjeldahl recommends an addition of zinc turnings to prevent bumping during the distillation of the ammoniacal liquid. Care must be taken that the soda-lye used is free from nitrates, as ammonia would be formed by their reduction. Only a slight excess of soda should be used, and as little zinc as possible, as otherwise a little soda may pass over into the receiver, as hydrogen gas, if evolved in large quantities, pulverises the liquid and carries it over in this condition.

The Recognition of Citric Acid.—C. Mann.—If citric acid is melted with glycerin in suitable proportions and evaporated to dryness at a gentle heat there remains a porous pale yellow mass which, when cold, is solid and brittle, but if covered with water while still warm it becomes transparent and takes the appearance of swelled gelatin. Water, alcohol, and ether dissolve very little of this substance, but it dissolves in strong sulphuric acid and in hot caustic alkalies. If this glycerin compound is dissolved by boiling in liquid ammonia, and the solution is allowed to evaporate spontaneously, the thickened liquid takes a faint green colour. If the original solution is freed as far as possible from excess of ammonia, diluted with water and mixed with solution of hydrogen peroxide, the colour appears at once. By an addition of red fuming nitric acid the green colour is also produced as soon as neutrality is reached. If the proportion of acid is right the green colour passes into a deep blue on applying heat. Tartaric and malic acid do not give similar reactions.

Analytical Apparatus.—R. Wollny.—The author describes and figures an extraction apparatus for liquids, an improved appliance for fractional distillation, a vaporimeter, a vacuum exsiccator, a thermo-regulator, and an apparatus for producing a continuous current of gas.

Reagent Bottles.—A. Gawalowski.—The improved bottles, the construction of which is shown in three accompanying figures, prevent the access of volatile matters and obviate the danger of the stopper becoming fast, even in case of caustic alkalies.

Burette for Liquids which Destroy Caoutchouc Tubing, or which are Liable to Reduction.—A. Gawalowski.—This apparatus cannot be intelligibly described without the accompanying figure.

Analysis of Soap.—A. Gawalowski.—In determining the fatty acids, by decomposing the soap with sulphuric acid, placing the fatty cake and the acid water beneath it in a folded filter, washing the cake in the cold, shaking up the filtrate and washings with petroleum ether, separating, evaporating off the ethereal stratum, &c., it is necessary that the filter should be air-dry before it is washed with petroleum-ether. This is a tedious operation, and it cannot be expedited by heat as the fatty acids would melt and occasion much trouble. The author expels the water from the filter by applying absolute alcohol, whereon the solution of fatty acids in petroleum ether passed through readily.

The Alkaline Reaction of Glass.—Prof. V. Wartha.—The author confirms the observations of Bohlig (vol. xxiii., p. 518).

The Use of Lime-water in Zinc Gasometers.—Julius Löwe.—The author has used lime-water for this purpose successfully for years. Milk of lime, however, is not to be recommended.

Qualitative Separation of Tin, Antimony, and Arsenic.—E. Berglund.—The author makes certain additions and explanations to his memoir (vol. xxiii., p. 537). He writes that copper oxide prepared by heating the nitrate is doubtless suitable for the purpose, but as copper is often arseniferous it is safer to use oxide obtained by precipitating copper sulphate with sodium carbonate and igniting gently. The metallic sulphides must be thoroughly washed before treatment with sodium sulphides, preferably with hot water. After the sulphides have been dissolved in a barely sufficient quantity of sodium sulphide it is well to add a little sodium hydrate to retain the antimony more securely in solution. The separation of the arsenic should be as follows:—After the addition of ammonium chloride a little ammonia is added, the mixture heated, and sulphuretted hydrogen is introduced. If the addition of ammonium chloride occasions no precipitate (tin) very little sulphuretted hydrogen is needed. But if the liquid contains a precipitate due to the ammonium chloride, the current of sulphuretted hydrogen must be continued till this is re-dissolved.

On Indicators in Alkalimetry and Acidimetry.—R. T. Thomson.—From the *Transactions of the Philosophical Society of Glasgow* for 1883.

Determination of the Specific Gravity of Liquids which can exist only under High Pressures.—A. Blümeke.—This paper is merely mentioned.

A Phenomenon which Occasions Difficulties in Polarisation.—Schmidt and Hänsch.—The authors investigate the causes of fluctuations in the angle of deflection.

A New Polarising Prism.—E. Bertrand.—From the *Comptes Rendus*.

Some New Laboratory Appliances.—A selection of brief notices on apparatus which require the accompanying figures.

An Apparatus for the Volumetric Determination of Large Quantities of Carbonic Acid.—R. Muencke.—This apparatus resembles in principle the well-known calcimeters, azometers, &c.

Magnesia Mixture.—G. Loges.—The author recommends for this purpose the double magnesium-ammonium chloride, which is not deliquescent. He dissolves 70 grms. of the double salt, and 55 grms. ammonium chloride in 1 litre of ammonia at 2·5 per cent.

Electrolytic Determinations and Separations.—A. Classen.—Already inserted.

A Double Aspirator.—R. Muencke.—A modification of the author's former apparatus.

Preparation of Sulphuretted Hydrogen free from Arsenic.—E. Divers and Tetsukichi Shimidzu.—From the Chemical News.

Separation of Arsenic from Tin and Antimony.—F. Hufschmidt.—The author has re-examined E. Fischer's method, which depends on the volatilisation of arsenicon distillation with ferrous chloride and hydrochloric acid (vol. xxi., p. 266), and obtains satisfactory results.

The Detection of Simple Cyanides in Presence of Compound Cyanides.—W. J. Taylor.—From the Chemical News.

The Reaction of Alcohol with Molybdic Acid.—E. W. Davy.—From the Chemical News.

Saccharification of Starch by Acids, and on the Intermediate Products, Soluble Starch, Dextrine, and Maltose.—Extracts from the *Journal für Praktische Chemie* and *Liebig's Annalen*, and not capable of useful abstraction.

MISCELLANEOUS.

The Royal Society.—At the Meeting of the Royal Society on June 4, the following candidates were elected Fellows of the Society:—Major A. W. Baird, R.E.; Philip Herbert Carpenter, D.Sc.; Sir Andrew Clark, Bart., M.D.; Andrew Ainslie Common, F.R.A.S.; Ettrick William Creak, Staff-Commander, R.N.; Prof. Edward Divers; Henry Hicks, M.D.; William Mitchison Hicks, M.A.; Francis R. Japp, Ph.D.; Arthur Milnes Marshall, M.D.; Prof. Henry Newell Martin, D.Sc.; Cornelius O'Sullivan; Prof. John Perry; Prof. Sydney Ringer; Sidney Howard Vines, D.Sc.

A Lucrative Invention.—Now the gold deposits of Australia, California, and Siberia have greatly fallen off in their yield, and now the Wynaad has proved to be a mere bubble, it will be satisfactory to our readers to learn that an entirely novel and unsuspected source of the precious metal has been discovered, and a process for its extraction invented and patented. The raw material is the wheat-plant—both straw and grain—not, apparently, grown in any particular soil, geological formation, or climate. In describing the process, it will be fairest to let the inventor speak for himself, *verbatim et literatim*, as follows:—"That in the steeping of the mixture of half, measure, the whole wheat straw cut into fine square snips the width of the straw and half the grains in a jar of ordinary cold water. I let the steep remain still for ten hours at a temperature of fifty-nine degrees Fahrenheit, varying with temperature, and then straining off the liquor into a shallow pan of some such cool substance as china or earthenware. I leave this liquor to stand in this pan for yet twenty-four hours at sixty degrees, also varying with temperature; these durations of times of ten hours and twenty-four hours, speaking for a very inferior brown straw, much knocked about, and the grains, those of a very good quality, of red wheat; and then catch up the skim on a cylinder of some such cool substance as china or earthenware, and then let this skim dry, so getting some results of films of gold." In a second patent the same inventor specifies a slightly modified process: a mixture of equal parts of snipped straw and grain is boiled for 2¼ hours; the liquid allowed to rest for 38 hours at 48° F., and is then baked slowly dry, when the gold is found adhering to the plates! We are not, of course, prepared to assert that traces of gold never occurs in the wheat-plant. But it may safely be said that if present at all they must be indeed infinitesimal. We should like to know if the inventor has really obtained satisfactory evidence of the nature of the films skimmed off the liquor or found adhering to the plates, and, above all, if he has determined the quantity and found it to be remunerative?

NOTES AND QUERIES.

*** Our Notes and Queries column was opened for the purpose of giving and obtaining information likely to be of use to our readers generally. We cannot undertake to let this column be the means of transmitting merely private information, or such trade notices as should legitimately come in the advertising columns.

Purification of Alcohol.—(Reply to J. B.)—29 and 30 Vict., Cap. 64, Sec. 9 :—" If any person shall, after any methylated spirit shall have been mixed with gum-resin for forming the mixture known as " Finish," or any like mixture, separate the gum-resin from the said " Methylated Spirit," or alter the said mixture in any manner except by adding thereto a further quantity of gum-resin, or any article for the sole purpose of colouring the same, he shall forfeit the sum of two hundred pounds, and the said spirit and mixture, respectively, so separated or altered as aforesaid, shall be forfeited, together with the vessels or other packages containing the same." In addition to the above there is a " General Order," of Aug. 9th, 1866, confirming the above.—W. H. Darling.

MEETINGS FOR THE WEEK

Tuesday, 16th.—Meteorological, 7.

Thursday, 18th.—Royal, 4.30.

—— Royal Society Club, 6.30. (Anniversary.)

—— Chemical, 8. Ballot for the Election of Fellows. " On the Decomposition and Genesis of Hydrocarbons at High Temperatures. (I.) The Products of the Manufacture of Gas from Petroleum," by Dr. Armstrong, F.R.S., and Dr. Miller. "On the Non-crystallisable Product of the Action of Diastase upon Starch," by H. Brown and G. H. Morris, Ph.D. " On the Decomposition of Carbon Dioxide at High Temperatures," by H. B. Dixon. " On the cause of the Decrepitations in Samples of Explosive Pyrites," by B. Blount. " On the Influence of Silicon upon the Properties of Cast-iron," by T. Turner.

THE CHEMICAL NEWS.

Vol. LI. No. 1334.

METHODS OF ANALYSING SAMARSKITE

AND THE OTHER COLUMBATES CONTAINING EARTHY OXIDES, BY THE AGENCY OF FLUORHYDRIC ACID; AND OF DISSOLVING COLUMBITE AND TANTALITE BY THE SAME ACID.—ON THE SEPARATION OF THORIA FROM THE OTHER OXIDES.—THE QUANTITATIVE ESTIMATION OF DIDYMIUM OXIDE IN ITS MIXTURES WITH OTHER EARTHY OXIDES.[*]

By J. LAWRENCE SMITH.

The study of this class of minerals has always presented considerable interest to the analytical chemist from the time of the discovery of columbite by Hatchett in 1801, and tantalite and yttro-tantalite by Ekeberg about one year later. These minerals for more than twenty years were the only known columbites and tantalites; since then about fourteen other well-defined species have been discovered and described, although the chemical formulæ of most of them are yet in doubt.

The metallic acids in these minerals have many interesting characteristics, which have already attracted special attention since H. Rose's researches in 1846 defining the distinctive characteristics of columbic and tantalic acid, which prior to that date had been considered by most chemists as being one and the same acid. M. Herman, and later M. Marignac, took up M. Rose's investigations and gave to them considerable extension. The former thinks that he has discovered two additional metallic acids of the same type in the minerals in which the first two are found. The metals of these acids he has called ilminium and neptunium.[†] The labours of M. Marignac, as set forth in his various publications,[‡] have contributed very largely to our precise knowledge of certain very important compounds of these acids, and he has also given the only reliable method of a close quantitative separation of columbic and tantalic acid.

An interesting chemical characteristic of these minerals is that nearly all of them have, as a portion of their bases, some one or more of the rarer earths, as the oxides of yttrium, erbium, cerium, thorium, and some new earths not yet fully defined. One reason for the comparatively imperfect study of the compounds of tantalum and columbium is the rarity of the minerals containing them; but since the discovery of comparatively large quantities of columbite and samarskite in the United States this difficulty is removed. Another obstacle to their study arises from the method of decomposing them, this being attended with more or less inconvenience when large quantities are to be operated on. This last difficulty will, however, be removed to a considerable extent by the analytical facts to be detailed in this communication.

In my published investigations in connection with the columbic and tantalic acid minerals from new localities in the United States[||] (more especially the remarkable developments of samarskite in North Carolina), the object in view was to detail all that was connected with their mineralogy, to describe the new species I had discovered, and to give a clear idea of their constitution in comparison with the same minerals as found elsewhere. In the analyses in that paper I did not give the relative proportions of columbic and tantalic acids, assigning as my reason at the time for this omission that the method I had worked with (Rose's) proved too unsatisfactory to warrant the waste of time in seeking after results that I was satisfied would be inaccurate. In this view I was sustained by M. Marignac, who has devised a much better method, which I have since tried, and which gives very good approximate results, within one and a half to three per cent, according to the amount of tantalic acid present. In the same paper I stated that the earths in samarskite did not appear to contain cerium oxide as does the Ural variety of the same mineral, though in the analyses then given I preferred noting the earths of that group as cerium oxides[*] till I could arrive at more satisfactory conclusions by renewed researches; for it is known that a small quantity of cerium oxide mixed with other oxides of that group may escape detection when the entire amount of oxides treated is very small; so it was thought better to repeat the experiments upon larger quantities before making any conclusive statement as to the presence or absence of cerium oxide. Thoria also, if present in the North Carolina samarskite, was there in too minute a quantity to warrant me in pronouncing upon it by the usual method of separation. All doubt, however, on this head has been dispelled by an easy and certain method I have discovered of separating it from the other earths, and, although present in the proportion of less than 1 per cent of the mineral, it can be separated and identified as well as any other constituent of the mineral, and that by operating with not more than 3 or 4 grms. of the mineral.

Method of Decomposing and Analysing Samarskite.

I shall first detail the method pursued in the analyses of samarskite, as this being one of the most complex of the columbates, all that is said in regard to it will be applicable to other forms of this class of natural compounds. The method most commonly employed for decomposing this mineral is by means of potassium bisulphate in the proportion of one part of mineral to six of potassium salt. This, it will be seen, introduces a very large amount of solid matter into the process, and, besides, requires careful heating to redness for some time. A more recent and better method is that proposed by Prof. Wolcott Gibbs,[†] viz., by the acid potassium fluoride (FlKFlHO). This method was used by M. Marignac in his most admirable and exhaustive labours on tantalic and columbic acid compounds already referred to. Concentrated sulphuric acid when heated with some of the columbates will decompose them more or less, but cannot be used in their analysis. The method about to be described is a decided improvement on either of the above for reasons that will be rendered very apparent.

Decomposition by Fluorhydric Acid.[‡]

The quantity of samarskite used in the analyses is usually five grms., and, having an abundance of the material, special portions are used for the verification of certain results. The precipitates of all the ingredients are so

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[*] From "Original Researches in Mineralogy and Chemistry," by J. Lawrence Smith, Membre Correspondant de l'Institut de France (Academie des Sciences), &c. Printed for Presentation only. Edited by J. B. Marvin, B.Sc., M.D. Louisville, Ky. 1884.

[†] *Jour. f. Prakt. Chem.*, xv., 105. Chemists are not ready to recognise these as new substances, but rather as mixtures of tantalic and columbic acids.

[‡] *Annales de Chim. et de Phys.*, viii., 1866, 115-175.

[||] *American Journal of Science*, May, 1877, 360.

[*] By this group is meant all the oxides forming insoluble double salts with the potash and soda sulphates, amounting to about four per cent of the mineral. Thoria, if present, was to be sought for among the oxides.

[†] *American Journal of Science*, xxxvii., 355.

[‡] Not many years ago this acid was made and used in comparatively small quantities, but owing to the extended use of it in the arts it is now manufactured on a large scale. One of the largest manufacturers of this acid in America is Feuchwanger, 118, Dey Street, New York, who furnishes a *fuming acid*, remarkably pure for a commercial article, at twenty-five cents per pound, in lead jugs of 30 lbs. capacity. The saturating property of 10 grms. of this acid is equal to that of 23 grms. of nitric acid of 1·42, costing 12 to 14 cents by the carboy, making the fluorhydric acid actually cheaper than the nitric acid. I have found in many laboratories what purports to be fluorhydric acid that is little less than sour water. When I desire pure fluorhydric acid I distil the commercial acid of Feuchwanger in a small platinum still and condense in a very little distilled water, the vessel being surrounded by ice. In this way there is no annoyance from fluorsilicic acid.

dense and granular that filters 7 to 10 centimetres in diameter are used except in the iron precipitate. The mineral is triturated to a fine powder, and 5 grms. dried at 150° C.,* weighed and placed in a small platinum capsule; one of 50 c.c. capacity is sufficiently large. This is moistened with about 5 or 6 c.c. of water, and then from 8 to 10 c.c. of concentrated fluorhydric acid is added (one-half at a time, with an interval of two or three minutes), and the mixture stirred with a platinum rod. In a few seconds a vigorous action takes place; the mass becomes heated, and in from five to ten minutes the decomposition is complete without the application of heat. If the powder be exceedingly fine the decomposition is almost as rapid as that of calc-spar when chlorhydric acid is poured upon it.

The action is known to be complete by the disappearance of every black particle in the mass. The capsule is now placed on the water-bath to ensure complete decomposition and to evaporate away the larger portion of the liquid.

After the reaction the contents of the capsule are, first, a clear colourless solution, and, second, a heavy green precipitate. The *solution* contains all the metallic acids, oxides of iron, and manganese. The *insoluble portion* contains all the earths and uranium oxide. It is true that traces of iron will be subsequently found in the analysis of the insoluble part and traces of earth in the solution, but they are easily separated in the course of the analysis, and properly placed in the estimates. They, however, only represent a fraction of one per cent.

It will be seen that thus far in a very few minutes the samarskite has not only been decomposed but partly analysed, for this perfect separation into two parts facilitates to a vast extent the subsequent operations.

To the contents of the capsule, decomposed as above stated, 30 c.c. of water are added; the whole is then warmed and thrown on a filter (8 c.c) in a gutta-percha or silver funnel, the filtrate being received in a platinum capsule. The filtration takes place very rapidly. and the precipitate is well washed with hot water, a few drops of fluorhydric acid being added toward the end of the washing, to prevent a trace of the precipitate passing through the filter, which might otherwise occur. The filtering and washing is accomplished in fifteen or twenty minutes. As already stated, we have two classes of substances completely separated from each other, one soluble, the other insoluble. The soluble we call A, the insoluble we call B.

We will first consider A. This solution is evaporated over a water-bath, and before it reaches dryness concentrated sulphuric acid is added in excess to decompose the fluorides; about 1 c.c. of acid to every grm. of metallic acid supposed to be present. The evaporation is completed by careful heating over the flame until the decomposition is complete and nearly all the sulphuric acid has been driven off. After cooling, water is added acidulated with chlorhydric acid, and the contents of the capsule washed out into a glass flask capable of holding 1 litre. When 5 grms. of the mineral have been used the liquid mass should be half a litre. A little chlorhydric acid is added. This is now boiled for one or two hours,† which can be done in an ordinary bottle.

After boiling, the contents of the vessel are thrown on a filter and thoroughly washed with hot water. The insoluble part remaining in the filter is columbic and tantalic acids, with a little tungstic and stannic acid. This is dried, ignited, and weighed with all the usual precautions, and afterward the tungstic and stannic acids are separated in the manner described by Rose, and the columbic and tantalic acids by Marignac's method.*

The filtrate from the metallic acids is concentrated, and as it contains only iron and manganese, with mere traces of other oxides, they are separated and estimated in the usual way by the sodium acetate method. This disposes of part A.

We now pass to the portion B, which is the insoluble part remaining after the first treatment with fluorhydric acid, and is composed of the fluorides of the earths and uranium. It is washed from the filter into a small platinum capsule. To this sufficient concentrated sulphuric acid is added to decompose the fluorides (about 2½ grms. suffice where 5 grms. of minerals are used), and the whole is concentrated as far as possible over a water-bath, and carefully heated over the flame until the excess of sulphuric acid is driven off, or very nearly so. After cooling, about 50 c.c. of water are added, and the capsule is gently heated on a water-bath, when the mass dissolves completely, furnishing a bright green solution. A minute amount of insoluble matter may sometimes show itself; this belong to the metallic acid, and is separated and added to that obtained from A. It is usually only a few milligrammes. The green solution is heated over the flame and a little nitric acid is added, when the colour is changed to a lemon-yellow, from the higher oxidation of the uranium oxide. The solution is now introduced into a beaker, and increased to about 250 c.c. by the addition of water, and made to boil. It is then very nearly neutralised by ammonia, and oxalic acid or ammonium oxalate added very gradually. The precipitate, as is well known, will be first taken up and afterward become permanent. It consists of all the earths present. This is allowed to stand some six or eight hours, then thrown on a filter and well washed. This oxalate of the earths I will call C, and proceed to treat of it a little further on. The filtrate contains all the uranium in solution with a trace of iron. This is concentrated to about 80 or 100 c.c., and then a concentrated solution of ammonium carbonate is added, which first precipitates the uranium oxide, and then re-dissolves it. The solution is nearly clear with the exception of a few flocci of ferric oxide. This is warmed gently, and a few drops of ammonium sulphide are added, which precipitates every trace of iron. That is washed and estimated in the usual way, and represents from two- to three-tenths of one per cent of the mineral, and is added to the ferric oxide obtained from solution A. The filtrate containing the uranium oxide is evaporated to dryness, the ammonium salts driven off, and the oxide estimated by the ordinary method. In all the analyses thus far no solid matter is introduced by the reagents.

Before quitting this part of the subject I would state that there is no columbate that does not readily yield to this treatment by fluorhydric acid, as euxenite, hatchettolite, fergusonite, &c., and so completely separate these minerals into classes of substances (the metallic acids in a state of solution and the earths as insoluble compounds), that the weighing of the acid decomposed by the action of sulphuric acid as described will give at once an idea of the quantitative composition of the minerals.

Columbite and Tantalite.

It is well to make some remarks in reference to the columbite and tantalite and their decomposition by fluorhydric acid, for they are more difficult to decompose by any method than are the columbites of the earths.

Before we had the more powerful and convenient methods of decomposing minerals, Berzelius, Rose, and others had to resort to the finest possible subdivision of the mineral, often using a flat slab of agate and triturating with water. This fine trituration is sometimes even now employed in our present modes of manipulation. As the method I have adopted for years is more convenient than any I know of in use, it will not be out of place to refer

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* Avoid heating to redness, for by so doing the mineral is not so readily acted on by the fluorhydric acid. I determine the loss by heat on a separate portion of 1 grm.

† In my laboratory the boiling of liquids containing a heavy precipitate is always accomplished by driving steam through a glass flask or small boiler, with two tubes, one bent at two right angles to drop in the liquid, and the other a straight one for a safety tube, thus preventing all thumping.

* *Annales de Chim. et de Physique*, viii., 1866, 115, 175.

to it here, for the whole operation is conducted in the same mortar in which the crushed mineral is first powdered.

If we have columbite to decompose, exceedingly fine dry trituration in an agate mortar suffices. To triturate properly one gramme of columbite will require from ten to fifteen minutes in a four-inch mortar. Thus pulverised, place the mineral in a platinum crucible or capsule, and add about 5 grms. of fluorhydric acid of the strength alluded to in the first part of the paper; then heat over the flame on a plate of iron, so as to bring the temperature up to from 60° to 90° C. Half an hour suffices for complete solution; if any black powder remains it is well to add a little more acid and heat again. A few flocci will sometimes appear in the solution, which is stannic oxide. In the analysis of tantalite the solution is not so easily accomplished, but I overcome that completely by my modification of the trituration of the mineral. After rubbing it up in the mortar for about five or six minutes I add a little strong commercial (95 per cent) or absolute alcohol to the contents of the mortar, enough to cover completely the powder, then continue the trituration. The alcohol will soon evaporate; add a fresh portion; this I may have to repeat several times. The alcohol, like any other liquid, enables the pestle to reach thoroughly the coarser particles that always settle to the bottom. To triturate thoroughly, 1 grm. of the tantalite requires about twenty minutes. The contents of the mortar are like imperfectly dried mud, and are kept at a temperature of about 150° C. in an air-bath for ten or fifteen minutes. A grm. of the material is then placed in a capsule or crucible of platinum, thoroughly dried and carefully weighed. About an hour suffices to complete the solution, which is a clear 5 grms. of the fluorhydric acid are now added, and the heating conducted as in the case of columbite. Half liquid with a few white flocci in it that I have proved to be stannic oxide. While this method of solution appears to be a little tedious, I can assure those who try it that the manipulations are very simple, and there is no soluble matter introduced as is the case when six or eight times its weight of potassium bisulphate is used. We now evaporate the solution of either columbite or tantalite to dryness; proceed as in the case of the samarskite. As there are no earths, however, in these minerals, there is little else than iron and manganese to deal with as associated with the metallic acids, which are decomposed by sulphuric acid for separation from iron and manganese as already indicated.

In regard to the separation of the two acids when they are in the same mineral, I use the method already referred to and first used by Marignac.*

The tungstic acid, stannic acid, &c., I estimate in the manner pointed out by Rose in his "Analytical Chemistry."

(To be continued).

Detection of Free Sulphuric Acid in Presence of Aluminium Sulphate.—O. Müller.—The author founds his process upon the property of methyl-orange (Orange III., or ammonium dimethyl-aniline diazo-benzol sulphate) of being coloured rose by free acid, but only orange by neutral aluminium sulphate. With this indidator he has detected 0·01 free acid per litre in presence of 0·6450 grm. aluminium sulphate, and even the dissociation of aluminium sulphate on boiling its aqueous solution. For the quantitative determination of the free acid the aluminium sulphate in question is extracted with cold alcohol, the alcoholic extract is evaporated down on the water-bath almost to dryness, the residue is taken up in cold water and titrated with decinormal alkali, using methyl-orange as an indicator.—*Zeitschrift f. Anal. Chem.*, Part 2, 1885.

A CATALOGUE OF CHEMICAL PERIODICALS.*

By H. CARRINGTON BOLTON, Ph.D.,
Professor of Chemistry in Trinity College, Hartford, Conn.

(Continued from p. 278).

Explanation of Signs.

+ Following a date signifies current at the date in question.
‖ Following a date signifies publication discontinued.

62. Chemisches Archiv. Herausgegeben von L. F. F. von Crell. 2 vols., 8vo. Leipzig, 1783.

Continued under the title:

[a] Neues chemisches Archiv. Herausgegeben von L. F. F. von Crell. 8 vols., 8vo. Leipzig, 1784-'91.

Followed by:

[b] Neuestes chemisches Archiv. Herausgegeben von L. F. F. von Crell. 1 vol., 8vo. Weimar, 1798.‖

Cf. Chemische Annalen: *also*, Chemisches Journal.

Chemisches Centralblatt.
See Pharmaceutisches Centralblatt.

63. Chemisches Journal für die Freunde ddr Naturlehre, Arzneygelahrtheit, Haushaltungskunst und Manufakturen. Entworfen von Lorenz Crell. 6 vols., 12mo. Lemgo, 1778-'81.

Continued under the title;

[a] Entdeckungen (Die neuesten) in der Chemie. Gesammelt von Lorenz Crell. 13 vols., 8vo. Leipzig, 1781-'86. ‖

Cf. Chemische Annalen für die Freunde der Naturlehre; *also* Chemisches Archiv.

64. Chemisch-pharmaceutisch archief; uitgegeven door J. E. de Vrij. B. Eickma en A. F. der Vliet. 2 vols. Schoonhoven, 1840, '41.

Chemisch-pharmaceutisches Centralblatt.
See Pharmaceutisches Centralblatt.

65. Chemisch-technischen Mittheilungen (Die) der neuesten Zeit; ihrem wesentlichen Inhalte nach alphabetisch zusammengestellt. Herausgegeben von L. Elsner [*later*, fortgeführt von F. Elsner]. 1846-'83. 33 vols., 8vo. Berlin, 1849-'84+

Sach-Register zu den ersten acht Heften der chemisch-technischen Mittheilungen der neuesten Zeit ihrem wesentlichen Inhalte nach alphabetisch zusammengestellt von L. Elsner. Die Jahre 1846-'59 enthaltend. 8vo. Berlin, 1860.

Sach-Register zu den bisher erschienen zwanzig Heften, [etc.]. Die Jahre 1846-'71 enthaltend. 8vo. Berlin, 1873.

66. Chemisch-technisches Repertorium. Ubersichtlich geordnete Mittheilungen der neuesten Erfindungen, Fortschritte und Verbesserungen auf dem Gebiete der technischen und industriellen Chemie mit Hinweis auf Maschinen, Apparate und Literatur. Herausgegeben von Emil Jacobsen. 1862-'82. 21 vols., 8vo. Berlin, 1863-'84.

General-Register zu Jahrg. xi.-xvii. [1872-'78]. 1 vol., 8vo. Berlin, 1879.

67. Chemist (The). [Edited by Mongredien ?] 2 vols., 8vo. London, 1824, '25. ‖

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* *Annales de Chim. et de Physique*, viii., 60, 1866.

* Advance-proofs from the *Annals of the New York Academy of Sciences*.

DELICACY OF SOME TESTS FOR ANTIMONY AND ARSENIC.

By SAMUEL RIDEAL, B.Sc., F.C.S.,
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The black stain or deposit obtained from acidulated solutions of salts of antimony on a platinum dish when a rod of zinc is introduced was shown by Fresenius to be visible when the solution contained 1 part by weight of antimony in 10,000 of the solution; but when the antimony was in the proportion of 1 to 20,000 the stain only makes its appearance after a lapse of fifteen minutes; with 1 to 40,000 the reaction is a doubtful one, and with 1 to 50,000 there is no stain at all (*Zeits. Anal. Chem.*, i., 445). In the Chemical News (vol. li., p. 267) Prof. Carter has described experiments in which he shows that 1 c.c. of a solution of tartar emetic containing 0·00003614 of a grm. of antimony gives a perceptible light brown stain on a strip of platinum 1 sq. cent. in size when in contact with a small piece of zinc. 1 c.c. of a solution containing 0·00005 of a grm. of tartar emetic, or 0·00001807 of a grm. of antimony, gave no stain whatever on the platinum, even after several trials. When, however, a piece of platinum wire with zinc wire wound round it was substituted for the platinum foil and granulated zinc, a black stain of antimony was visible on a part of the wire after the zinc had been dissolved off.

Last year, when trying some experiments on the detection of small quantities of either arsenic, antimony, or tin in the presence of one another, I had occasion to use a modification of Tookey's method for separating tin and antimony, after having first removed any arsenic present by distilling with hydric chloride and ferrous chloride in the manner recommended by Fischer. The method employed consisted in using to precipitate the antimony a piece of iron wire about one-sixteenth of an inch in diameter and from 1 to 2 centims. in length, round which was spirally wound a piece of fine platinum wire. Preliminary experiments were tried on the detection of each metal separately, a description of some of which is the purpose of the present note.

In the case of antimony, acid solutions of antimonious chloride were prepared containing 0·0012, 0·00012, and 0·000012 of a grm. of antimony in each c.c. respectively. When this couple of iron and platinum was used with 1 c.c. of these solutions a distinct black stain was obtained on the platinum in each case. The best results by this method are obtained when the platinum wire is thin and the coils many and close together. It is also advantageous to have one end of the platinum wire standing out of the solution, to serve the double function of being a handle to remove the metals when the action is complete, and of affording a contrast by its brightness to that part of the platinum which becomes darkened with the antimony stain. Care should also be taken to prevent the oxidation of the ferrous chloride in the solution, as the precipitated antimony is soluble in an acid solution of a ferric salt.

A comparison was made on the delicacy of this test with that of sulphuretted hydrogen for this metal. When sulphuretted hydrogen gas was passed through the same solutions, the following results were obtained:—2 c.c. of a solution containing 0·00024 of a grm. of antimony gave a decided precipitate; 2 c.c. of a solution containing 0·000024 of a grm. of antimony gave only a very faint orange colouration, although 5 c.c. of the same solution containing 0·00006 of a grm. of antimony gave a small but distinct precipitate. The method described, then, is considerably more delicate than that based on the precipitation of antimonious sulphide, and responds to a smaller quantity than that described by Prof. Carter.

For arsenic, solutions of arsenious acid acidified with hydric chloride were employed, and a fine copper wire was used instead of platinum for the spiral. The grey deposit of metallic arsenic, or alloy of copper and arsenic, formed could be readily seen on the red surface of the copper. A distinct grey film was obtained with 1 c.c. of a solution containing 0·000015 of a grm. of arsenic acid, and also with 1 c.c. of a solution of half that strength, containing, therefore, 0·0000075 of a grm. of arsenic.

The delicacy of this test was compared with that of sulphuretted hydrogen in acid and silver nitrate in neutral solutions of arsenious acid.

When sulphuretted hydrogen gas was passed into 1 c.c. of a solution containing 0·00002 of a grm. of arsenic as arsenious acid only a faint colouration was produced, but with a solution containing 0·00004 of a grm. a perceptible precipitate was obtained. With silver nitrate solution a faint lemon-yellow precipitate was obtained with 1 c.c. of solutions containing 0·000375, 0·0000375, 0·00001575 of a grm. of arsenic as arsenious acid respectively. To the one c.c. of the solution in a narrow test-tube, a few drops of decinormal silver nitrate solution were added, and then weak ammonia solution (10 c.c. of 0·880 ammonia in 1 litre of water) poured on gradually by means of a pipette. When small flat-bottomed test-glasses standing on black paper were used a distinct precipitate could be obtained from 0·0000196, 0·0000098, 0·0000049 of a grm. of arsenic in 1 c.c. of solution.

Similar experiments were tried with a solution of stannous chloride, using a rod of zinc wound round with a piece of gold wire to precipitate the metal. 1 c.c. of a solution containing 0·00003 of a grm. of tin as stannous chloride gave a faint grey metallic film upon the part of the gold wire immersed in the liquid.

I have to thank Professor Williamson for suggestions whilst carrying out these few experiments.

PROCEEDINGS OF SOCIETIES.

UNIVERSITY COLLEGE, LONDON.

Chemical and Physical Society.

Thursday, June 4th, 1885.

C. E. Cassal, F.I.C., F.C.S., President, in the Chair.

A Paper was read by E. Ernest Graves, F.C.S., "*On the Influence of Moisture on the Combination of Gases.*"

The author began by asking whether any ordinary student, on hearing that two volumes of hydrogen and one volume of oxygen when exploded form two volumes of steam, ever thought to enquire what influence, if any, outside circumstances had on this action? Problems such as this have only recently been worked at, and the difficulties to be encountered are many, as the reactions are as a rule complex.

Mr. Dixon's researches on hydrogen, carbonic oxide, and oxygen are important in this study, as are those of Meyer, Horstmann, Bunsen, and others. Henry was the first to observe that at low temperatures oxygen has greater attraction for carbonic oxide than hydrogen when a spark is passed through the mixture; the reverse being the case at high temperatures. Bunsen found that the oxygen divided itself in the ratios of the carbonic acid to water in the six hydrates of carbonic acid.

Meyer, in 1874, confirmed Bunsen's results, but found that in presence of nitrogen the carbonic acid was formed in greater, and the water in less, proportion than in the absence of nitrogen.

He also found that the coefficient of affinity depended on the tube employed, more water being formed in a small than in a large tube: this he attributed to the increased friction in the narrow tube.

Mr. Dixon began by repeating Bunsen's experiments, and then carried on an investigation to see whether if oxygen be exploded with excess of combustible gas the oxygen is all used or not. He fired a mixture of three volumes of carbonic oxide with one volume of oxygen in a *wet* tube with the following result:—

Before explosion	100 vols.
After explosion	75·9 „
Contraction	24·1 „
After absorption	25·1 „
Absorption	50·8 „

Showing that 0·8 volume of carbonic oxide must have been oxidised by the steam. He also found that *dry* carbonic oxide and oxygen will not explode on passing a spark through them. It is therefore probable that the carbonic oxide does not react directly with oxygen, but that the steam is necessary as a carrier.

The experiments of Mr. Dixon show that Bunsen's work was vitiated by the presence of water, and that the theories, formed in accordance with his results, are untenable.

Samuel Rideal, *Hon. Sec.*

MANCHESTER LITERARY AND PHILOSOPHICAL SOCIETY.

Annual General Meeting, April 21st, 1885.

J. P. Joule, D.C.L., LL.D., F.R.S., &c., Vice-President, in the chair.

The Treasurer reported that enquiries had been made relative to the cost of the restoration of the old building; this would involve an expenditure of at least £500. He had much pleasure in informing the Society that one of their members, Mr. Henry Wilde, in addition to his recent benefactions to the Society, had also undertaken the restoration of the building at his own cost.

On the motion of Mr. C. Bailey, seconded by Mr. R. S. Dale, it was unanimously resolved—"That the thanks of the Society be given to Mr. Wilde for his additional benefaction."

The Treasurer also reported that the Council had accepted the offer of the Microscopical and Natural History Section to furnish the room over the library at the expense of the Section.

A letter was read from Mr. J. Baxendell stating that, on account of his continued ill-health, he wished to resign the office of Honorary Secretary, which he had held for twenty-four years.

The Report of the Council, April, 1885, was then read.

On the motion of Mr. James Smith, seconded by Mr. John A. Bennion, it was resolved—"That the Annual Report be adopted and printed in the Society's *Proceedings*."

On the motion of Mr. Alfred Brothers, seconded by Mr. Richard S. Dale, it was resolved—"That the system of electing Sectional Associates be continued during the ensuing session."

The following gentlemen were elected officers of the Society and Members of Council for the ensuing year:—

President—William Crawford Williamson, LL.D., F.R.S.

Vice-Presidents—Sir Henry Enfield Roscoe, B.A., LL.D., F.R.S., F.C.S, James Prescott Joule, D.C.L., LL.D., F.R.S., F.C.S., Osborne Reynolds, M.A., F.R.S., and Joseph Baxendell, F.R.S., F.R.A.S.

Secretaries—James Bottomley, B.A., D.Sc., F.C.S., and Arthur Schuster, F.R.S.

Treasurer—Charles Bailey, F.L.S.

Librarian—Francis Nicholson, F.Z.S.

Other Members of the Council—Robert Dukinfield Darbishire, B.A., F.G.S., Balfour Stewart, LL.D., F.R.S., Carl Schorlemmer, F.R.S., William Henry Johnson, B.Sc., Henry Wilde, and James Cosmo Melvile, M.A., F.L.S.

One of the Secretaries then read the following account of the life of Dr. Robert Angus Smith, which had been drawn up by Dr. E. Schunck at the request of the Council:—

Robert Angus Smith, a man whose name will always find a place in the annals of our Society, has passed away since our last annual meeting. His was a life of which it is difficult to form a just estimate, on account of the many-sidedness of his character and attainments. His contributions to science and literature will, indeed, always remain accessible to the judgment of posterity, but there is much in his character and his relations to the world which should be recorded ere those who knew him have also passed away. In his case, fortunately, the record may be perfectly unreserved, for here there are no blots to be concealed, no dark shadows to be passed over.

Robert Angus Smith was born in Glasgow, February 15th, 1817, being the twelfth child and seventh son of John Smith, a manufacturer of that city, and of Janet his wife, daughter of James Thomson, who was an owner of flax and other mills at Strathavon, where he held the office of baron-baillie. Of the brothers, those who attained to maturity were all men of remarkable intellect. The eldest, John Smith, was for many years a master in the Perth Academy, and paid great attention to optics, a paper of his having been printed in the *Memoirs* of this Society. James Smith, a man of highly original character, was the author of several works on religious and philosophical subjects. Another brother, Michaiah, was a distinguished oriental scholar, while Joseph, the youngest, devoted himself to science, but unfortunately died early. The father was by all accounts a very earnest man, with profound religious convictions, and though not highly successful in worldly pursuits was able to give his sons a good education, such as the schools and universities of Scotland were and are presumably still able to offer even to men of moderate means. Two of the sons, James and Michaiah, were ordained ministers in the Scotch church. At that time, however, the Irvingite schism was exciting the minds and engaging the sympathies of many, especially the young, and it is probable that the father, as well as several of the sons, felt attracted by the doctrines promulgated by Irving, doctrines which could not possibly find sufficient scope within the somewhat contracted sphere of a Calvinistic communion. So far as our friend is concerned it is certain that his sympathies led him more in the direction of Anglicanism, and from the hints he let drop at various times it seems that it was only through circumstance that he was prevented, when a choice was possible, from taking orders in the English church. After passing through the usual course at the Glasgow High School, and spending some time at the University of Glasgow, a period of his life of which he seldom spoke, simply perhaps because there was little to say, Dr. Smith accepted a post as tutor to a family in the Highlands, but was soon compelled to leave from ill-health. He then proceeded to England, where he was employed in a similar capacity in families, whose peculiar religious opinions give some indication of the direction in which his sympathies at that time tended. With the Rev. and Hon. H. E. Bridgeman he spent two years, and with him proceeded to Germany. So far Dr. Smith's tastes and occupations had been purely literary and theological. His education had been entirely classical, comprising a knowledge of ancient languages, such as was in his day thought sufficient for all the purposes of life, an acquaintance with science, mathematics, or modern languages being then considered of little consequence. During his stay in Germany one of the tendencies of his many-sided mind revealed itself. Hearing of Professor Liebig, whose fame was then spreading through Germany, his attention was directed towards science, this tendency being perhaps encouraged by the example of his brother Joseph, who had engaged in the study of chemistry under Professor Penny, of Glasgow, and with whom he corresponded. He accordingly proceeded to Giessen, where he worked in Liebig's laboratory during the years 1840 to 1841, and where, before leaving, he took the degree of Ph.D. During his stay at Giessen he extended his knowledge of the German language and literature, and also paid much attention to German systems of philosophy, a subject that at all times interested him greatly.

It may perhaps be considered a matter for regret that Dr. Smith's early training in science was not more extensive, and that it continued for so short a time. On the other hand, it is possible that a more rigorous training in natural science and mathematics might have detracted from the catholicity of mind and wide culture which were prominent characteristics of his. He afforded, indeed, a conspicuous example of what the conservatives in education always insist on, viz., that a thorough classical training affords a basis on which a superstructure consisting of any kind of speciality may be confidently erected, though, on the other hand, it is hardly a safe proceeding to found general rules on such exceptional cases as his. Soon after leaving Giessen, Dr. Smith published a translation of Liebig's work "On the Azotised Nutritive Principles of Plants." After his return to England at the end of 1841 Dr. Smith was engaged in various capacities with families of distinction, and at this time the early inclination for a theological career seems to have revived, and was probably only given up when it was found that circumstances, such as the necessity for a preliminary education at an English University, placed an insuperable barrier in the way. In the year 1843 we find him working as assistant to Dr. Lyon Playfair, with whom he had become acquainted at Giessen, and who was then engaged as Professor of Chemistry to the Manchester Royal Institution. At Manchester Dr. Smith finally settled down; here, with the exception of intervals of travel, he spent the rest of his life, and here all his most important work was done. With characters combining many-sidedness with great intensity of purpose it is often a mere accident that determines the direction the energies shall take. Such an accident occurred in the career of Dr. Smith. The Health of Towns Commission, of which Mr. Edwin Chadwick was the moving spirit, came to Manchester, as to other towns, to institute inquiries. Dr. Playfair was much interested in these inquiries, and Dr. Smith was engaged in conducting some portion of them, their object being more practical than scientific. This circumstance directed Dr. Smith's attention to sanitary matters, and led him to commence the series of investigations which occupied a great part of his time and attention from the year 1844 up to the time of his death.

At the time when Dr. Smith commenced his researches sanitary science did not exist, unless a mere collection of unconnected facts can be dignified with the name of science. Since that time much more system has been introduced into the subject, and a great portion of the merit of having developed the purely scientific side of it is due to Dr. Smith. The pathological side of the subject did not, of course, receive as much attention from him as the purely physical; nor did he, we think, at any time pronounce decidedly on the question whether the phenomena with which sanitary science deals are purely organic in their nature, or whether they are not also partly due to merely physical causes. What he did was to investigate patiently the physical and chemical conditions as regards outward agents, more especially the air we inhale and the water we drink, on which health and disease seem to depend. No doubt, since the time when Dr. Smith entered the field, our views on this subject have altered considerably. It is now held that most diseases, especially those of the zymotic class, are due to the development of organic germs, but the most ardent advocate of the germ theory must allow that there are physical and chemical phenomena attending disease which must not be neglected, and to these Dr. Smith chiefly confined his attention, now and then only reverting to the general question of the causes of disease, as to which he was always prepared to change his opinions when the progress of discovery required him to do so. The results of his labours are contained in a series of papers, of which the Royal Society's catalogue contains a list, though an incomplete one, beginning with one entitled "Some Remarks on the Air and Water of Towns," published in the Chemical Society's *Journal*, 1845—48. His results are summed up in an independent work entitled "Air and Rain." Much of Dr. Smith's work was necessarily of a purely qualitative character, for the phenomena which he investigated are concerned with almost infinitesimal quantities of matter. Nevertheless, whenever it was possible, he introduced quantitative methods, as when examining the amount of carbonic acid contained in the atmosphere, of which an account will be found in his paper "On Minimetric Analysis," read before this Society in the session 1865—66. This paper contains a description of a very simple and ingenious little apparatus, called by him a "finger-pump," by which the amount of impurity in the atmosphere, in the shape of carbonic acid or hydrochloric acid, can be rapidly and easily determined. On disinfectants, to which Dr. Smith's attention was naturally directed, he worked much, his general views on the subject being contained in a separate work published in 1869, and entitled "Disinfectants and Disinfection." The practical result of his studies in this direction was the invention of a very useful disinfectant which was introduced by Mr. McDougall, and is still largely employed. This short résumé of Dr. Smith's labours on air and water in their hygienic relations must suffice for the present occasion, but before closing it we must not omit to name his able report "On the Air of Mines," chiefly those of Cornwall, presented to Government, by whose directions the inquiry into the atmospheric conditions prevailing in mines was undertaken. Dr. Smith's memoirs on other scientific subjects are not numerous. Among them may be mentioned those on rosolic acid, on the absorption of gases by charcoal, which he supposed to take place in certain definite proportions, and on the "Measurement of the Actinism of the Sun's Rays and of Daylight" (*Proceedings of the Royal Society*, xxx., 355), in which a novel method of measurement is described. His study of peat, which treated of a favourite subject of his, was perhaps more practical than scientific in character.

This is, perhaps, not the place to mention in detail his work in connection with technical subjects, but one of his inventions must not be passed over in silence, viz., that for coating iron tubes with an impermeable varnish, so as to preserve them from corrosion. Of this invention experts entertain the very highest opinion, and it may safely be said that, had he been endowed with more worldly prudence, he might, by this invention alone, have amassed a considerable fortune. Like many other inventors he never enjoyed the rewards to which his ingenuity entitled him—it is for the world to acknowledge, by words at least, the benefits he conferred on it—for those who are unable or unwilling to fight and struggle for wealth and position it has no other recompense to offer.

In the year 1864 Dr. Smith was appointed chief inspector under the Alkali Act, which had just previously been passed by the legislature, a post for which he was, from his intimate knowledge of atmospheric contamination, eminently fitted. Great complaints having arisen regarding the injury done to crops and other things by the emanations from alkali works, an Act was passed the object of which was to limit the amount of injurious gases, especially hydrochloric acid, which should be allowed to escape from the flues of alkali works.

It was this Act the provisions of which Dr. Smith, with the aid of his sub-inspectors, was to see carried out by constant supervision on the part of the sub-inspectors, and frequent periodical visits to various districts by himself.

That he was eminently successful in his attempts to secure for the public the benefits which the legislature had in view when the Act was passed, and, on the other hand, in conciliating by his prudence and tact those who were to some extent restricted and interfered with by the provisions of the Act, is universally conceded. It is quite possible that in other hands the task which Dr. Smith was called on to perform might not have been accomplished, and the result might have been complete failure. To continue what he began according to methods initiated by him is a comparatively easy task. As chief inspector under the Alkali Act Dr. Smith had each year to present a report of the proceedings under the Act for the preceding year. These reports, of which the last presented in 1884 was the twentieth of the series, contain much information over and above what mere official summaries might be expected to give, and they should be carefully studied by all who are interested in hygiene in its relation to manufactures.

In the year 1876 an Act similar to the Alkali Act, though of a less stringent character, was passed styled the "Rivers Pollution Prevention Act." Under this Act Dr. Smith was appointed to examine polluted waters, more especially the state of effluent fluids from sewage works, and he presented two reports to the Local Government Board as an inspector under the Act. To the results set forth in the second of these reports, presented shortly before his death, Dr. Smith attached the greatest importance. It will be for others to judge of the value of these results, but he himself considered that the discoveries described in the report would open up a wide field of research, throwing quite a new light on the relations between disease and water and soil.

To those who take an interest in sanitary science it must be a matter for vivid regret that his labours on this novel field of research were cut short just when they seemed to promise important results.

It remains to say a few words on such of Dr. Smith's publications as are not of a scientific or professional character. These are partly philosophical in their tendency, partly literary, or simply popular in character, and in part treat of antiquarian subjects, for which Dr. Smith had a great liking, and seem often to have been hastily penned to fill up a leisure hour, or at the request of friends. Many of them were anonymous, but Dr. Smith's style and the current of his thought were so original that to those who knew him the disguise was only a thin one. One of the works belonging to this class must not, however, be passed over without special notice. During several years of the latter portion of his life he was in the habit of spending his autumn vacation on the shore of Loch Etive, in Scotland, where he employed himself—his active mind never being satisfied without some special object to occupy it—in exploring this part of his native country with a view of throwing some light on its state in prehistoric times. The result was a work, which is not only instructive, but highly entertaining in the best sense, called "Loch Etive and the Sons of Uisnach," a work which all should read who are interested in prehistoric research and ethnology. Dr. Smith paid great attention to Celtic languages, and made a large collection of works in Gaelic. These, with the rest of his books, have, since his death, been presented to the library of Owens College.

Dr. Smith was elected a member of this Society in the year 1844. For several years he acted as one of the secretaries of the Society, subsequently he was elected a Vice-President, and during the sessions 1864 and 1865 he filled the post of President. He at all times took a lively interest in the welfare of the Society, and was always ready with advice and active assistance when such were required in the transaction of business.

In connection with this Society he will, however, be chiefly remembered by two works, the "Life of Dalton and the Atomic Theory" and "A Centenary of Science in Manchester," which were written at our request, and form two volumes of our series of memoirs.

Into the merits of those works it will be unnecessary to enter, as they must be well known to all the members. For the last work we are under peculiar obligations to him, as it was undertaken contrary to the advice of his friends at a time when his health was declining, and he was already overburdened with other work.

He was also a Fellow of the Royal Society and of the Chemical Society of London, and a member of several learned societies on the Continent. Had he been more of a specialist it is probable that the list of the societies that have sought to honour him by membership and in other ways would have been longer. In the year 1881 the degree of LL.D. was conferred on him by the University of Glasgow, a distinction which coming from his alma mater, the seat of learning in his native town, he valued highly. The same degree was awarded to him by the University of Edinburgh in 1882

Dr. Smith's health had evidently been declining for some years. Not endowed with a very robust constitution, and unable, as it appeared to some, to take the amount of sustenance required for so active an existence as his, the great labours which were partly imposed on him, and partly undertaken voluntarily, began in time to tell on his health. To the entreaties of his friends to allow himself some rest he did not reply by a direct refusal, but continued to work on with unabated zeal, as if the stock of vigour he had to draw on were inexhaustible.

Various changes of scene were tried, but without effect, and he gradually sank, the bodily strength declining but the mind remaining clear to the last. He died at Colwyn Bay, in N. Wales, on the 12th May, 1884. His remains were interred in the churchyard of St. Paul's, Kersal, near the spot where one of his oldest and most intimate friends hopes some time also to rest.

This notice would not be complete without some reference to Dr. Smith's moral characteristics. To most of us these were familiar, but those who come after us should know that in his case an intellect of high order was united to a character of the purest and noblest type. The most marked trait in his character, it seems to us, was a wide, to some it might seem an almost inconceivably wide, benevolence, a benevolence which seemed capable of embracing all except the unworthy within its folds. It was this that led him to associate with men of the most diverse character and aims, extracting from each specimen of humanity a something with which he could sympathise, putting on one side or excusing what was uncongenial to his nature in each, and establishing bonds, some stronger, some weaker, which in their totality gave him a sense of relationship to humanity at large. This wide toleration may serve to explain a fact which may sometimes have been observed, that two men mutually repellent and unwilling to associate together might both have been warm friends of his. To us he seemed sometimes to be the centre of a system or constellation, the individual members of which knew little of each other, but were all united to him by bonds of sympathy. His extreme conscientiousness and high sense of honour appear even in his works, leading him scrupulously to weigh all that could be said on either side of an argument, and to give every man his proper share of merit, refusing sometimes even to credit himself with what was manifestly his due. This great conscientiousness was occasionally even injurious to him by hindering him in arriving at positive and precise conclusions such as the world requires even when there is no thorough conviction.

Of the charms of Dr. Smith's conversation, only those are able to form an idea who had the pleasure of his personal acquaintance, for it was not of a kind to be reproduced in set phrases. Without being at all eloquent or indulging in harangue, and giving due weight to everything his hearers had to say, he was able, from the fulness of his knowledge and the originality of his views, to throw a new light on almost every subject he touched on; and thus he would sometimes continue to instruct without dogmatising, and entertain without wearying, until it was found that not minutes but hours had slipped away in listening.

One trait in Dr. Smith's character must not be passed over, though to mention it in this age of materialism may seem to require some apology: he was a firm believer in a spiritual world, that is, of a world above and beyond the senses, of the reality of which, whether we can communicate with it directly or not,—and of this he never seemed quite sure—he was firmly convinced. Those who remain to lament his loss, and who share the same belief, may unite in the fervent trust that in the world of which he thought much but spoke little, his spirit may have found not merely rest and satisfaction, but also a continuance of that mental activity and development which to him were life.

Dr. Smith was never married, but for many years his niece, Miss Jessie Knox Smith, was his constant companion and confidant, ministering to him with a zeal and devotion which could not have been exceeded had the relationship been that of father and daughter.

"*On a Variation in the Size of an Image on the Retina according to the Distance of the Background on which it is seen*," by Alfred Brothers, F.R.A.S.

The effect on the retina when the eyes have been fixed intently for a few seconds on a brightly illuminated coloured object is well known,—the colour complementary to the one looked at always appears when the gaze is removed to a colourless surface. It is also a matter of common observation that when the eyes have been directed to a bright light for a short time the image left on the retina as seen when the eyes are averted is *dark;* but if the eyes are rapidly opened and closed the image is still seen *bright.* I am not aware, however, that it has ever been noticed that this image varies in size according to the distance of the background to which the eyes are directed. A circle of gas-jets, perhaps, affords the simplest test. It will be seen, after looking at the circle of light for a few seconds (in some cases a more or less lengthened gaze at the light is necessary, owing to the varying sensitiveness of the retina), that, if the vision be turned to a distant background, the size of the image is instantly enlarged, and then, if the eyes be directed to a near background, the image is reduced in size. If any difficulty should be found in seeing the reversed image of the gas-jets, it may readily be seen as a bright object by rapidly closing and opening the eyelids. The effect is the same as if the image were seen through a cone—the apex of the cone being held close to the eyes. In other words, the effect is the reverse of the ordinary rules of perspective.

CORRESPONDENCE.

COAL-TAR ANALYSES.

To the Editor of the Chemical News.

Sir,—I beg to inform you that I quite agree with "Tar Distiller's" account of analysis for estimating the market value of coal-tar. I may mention that I have worked upon the same principle in analysing several of the North Country coal tars; but I wish to put before "Tar Distiller" that in giving the per cent of anthracene oil, I also gave the percentage of anthracene cake pressed from the oil, and then gave test of same, testing with Meister, Lucius, and Bruning method of analysis. Owing to anthracene being the chief and most expensive product of coal-tar, I think tar distillers will agree with me that it is requisite in ascertaining the per cent of cake in the anthracene oil; and another instance why this should be carried out by tar distillers is because that different samples of tar vary considerably in quantity and quality of anthracene. In conclusion, I beg to give the method I use in getting the percentage of cake anthracene. Having taken the weight of the anthracene oil, I place it into a shallow dish and allow it to stand in a cool place 48 hours, then filter through a very fine cloth and allow the filtered oil to stand for another 24 hours, and again filter, fold the anthracene carefully up, then put it into a press, and after pressing weigh, and deduct same from the original sample of anthracene oil.—I am, &c.,

T. B. Reay.

Laboratory, The Wear Fuel Works, South Docks,
Sunderland, June 16, 1885.

ESTIMATION OF NITRIC ACID IN WATER.

To the Editor of the Chemical News.

Sir,—In your review of the "Proceedings of the American Pharmaceutical Association" you speak of a process for the determination of nitric acid in water by means of a form of copper-zinc couple as "not generally known;" it is the invention of Williams, an Englishman, and I believe also a pharmacist, and is one of three alternative tests allowed by the Analysts' Society in their scheme of water analysis. Williams, however, uses the far more convenient, though, perhaps, somewhat less accurate, Nessler process for the determination of ammonia formed, in place of that with mercuric chloride. I have used the process for some years, and can bear witness to its convenience and accuracy; a full description, with a slight modification suggested by myself, to obviate the necessity for distillation, and also for determining ammonia originally present in the water, will be found in the last edition of Sutton's "Volumetric Analysis;" not having the volume at hand I cannot give the exact reference.—I am, &c.,

Thomas P. Blunt.

CANNED MEATS.

To the Editor of the Chemical News.

Sir,—I think the rules to be observed in the case of purchasing "canned" meats, &c., ought to be made widely known.

From Dr. Johnson's paper we can very readily see to what dangers the public are exposed, but at the same time how best to guard against them.

If some one were to have the paper on p. 268 of the Chemical News printed and sent to every newspaper, periodical, &c., in the kingdom, I am sure a great good would be the result.—I am, &c.,

J. H. B.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

Note.—All degrees of temperature are Centigrade unless otherwise expressed.

Zeitschrift für Analytische Chemie.
Vol. xxiv., Part 2, 1885.

On Indicators.—Dr. G. Lunge points out that in the case of sulphites the gradual transition of colour in litmus and phenacetoline is due to the circumstance that an acid salt colours litmus red and phenacetoline yellow, whilst the perfectly saturated salt colours litmus a pure blue and phenacetoline a red,—the intermediate stages being mixed colours. F. A. Flückiger has investigated the sensitiveness of phenol-phthaleine; 10 c.c. of a solution containing 1 part phenol-phthaleine in 3 million parts of liquid were turned distinctly red by a few drops of decinormal soda. The action of ammonia is transitory, since a faintly ammoniacal solution loses its original red colour as the ammonia evaporates. This occurs in a more marked degree if phenol-phthaleine paper is placed in an ammoniacal solution. It is reddened at first, but unlike the fixed alkalies, it becomes colourless on exposure to the air. Inversely a solution of sodium bicarbonate saturated with carbonate acid, which has an alkaline reaction with litmus, is at first not coloured at all by phenol-phthaleine, but turns red on standing. A reddened solution of phenol-phthaleine is decolourised by a number of bodies, which with litmus are slightly or imperceptibly acid, such as boric and arsenious acids, potassium bichromate, and even gum arabic. The neutral salts of the heavy metals which are acid to litmus likewise decolourise reddened phenol-phthaleine. All the salts of ammonia, and those of the alkaloids, act upon phenol-phthaleine like free acids. The fixed alkaloids have no action either in an aqueous or an alcoholic solution. With coniine, Flückiger observed a strong, and with nicotine a slight, reddening, but he suggests that ammonia may have possibly been present. B. S. Proctor has studied methyl orange as an indicator, and especially its use for detecting free acid in presence of salts which have an acid reaction with litmus. He mentions that this colour, which is turned from yellow to red by minimal quantities of free mineral acids, is little susceptible to oxalic acid, less to acetic, and is not affected at all by carbonic acid. Neutral ferrous sulphate does not modify the colour, but a trace of free sulphuric acid produces reddening. The indicator behaves in the same manner with zinc sulphate and with alum. A trace of free sulphuric acid gives reddening; on supersaturation with ammonia the colour of the liquid, which had simultaneously become turbid, is rendered yellow again. If sulphuric acid is added afresh the red colour appears, but disappears again until all the precipitated alumina is re-dissolved, when a permanent colouration is established. The detection of free acid in presence of ferric chloride is less successful, as there are no well-marked changes of colour. Mercuric chloride occasions a reddish tint, which disappears again on adding ammonium chloride. Calcium chloride produces no change of colour. Superphosphate gives a colour only when it contains more phosphoric acid than is required for the formation of soluble calcium phosphate. Calcium bicarbonate does not affect the colour of methyl-orange, but the redness occasioned by a minimum of free sulphuric acid disappears, so that we have here a good method of ascertaining if water possesses temporary hardness. Potassium bitartrate occasions a reddish tint, which is not essentially modified by the addition of small quantities of alkali or of tartaric acid. Sulphurous acid occasions a redness even in small quantities, and does not bleach in excess. Arsenious, boric, and hydrocyanic acids have no action. Free tartaric and citric acids occasion redness even in small quantities.

A Modification of the Dumas Process for the Determination of Nirtogen.—G. Stillingfleet Johnson.—From the CHEMICAL NEWS.

Determination of Tannin.—R. Jackson gives in the CHEMICAL NEWS a process in which lead carbonate is used in place of the powdered hide employed by Hammer. August Vogel recommends, in titrating tanning with gelatin solution, an addition of ammonium chloride to make the precipitate settle more readily. Rouquez for the same purpose adds freshly precipitated barium sulphate. P. Carles makes his gelatin liquid by dissolving 2 grms. purest gelatin in 1 litre boiling water, adds 150 grms. laurel-water, and makes up to 1500 c.c. This solution is said to keep for months without spoiling. Durien proposes to mix a solution containing a known weight of tannin, and also one of the sample in question, with a slight excess of ferric chloride, and then to dilute until only a faint black-blue colour appears. Clear solution of chloride of lime is then added drop by drop, and from the volume of the latter used in each case the proportion of tannin in the unknown solution can be calculated. Adolpho Casali uses a neutral solution of nickel sulphate containing ammoniacal salts for the precipitation of tannin, and he adds small quantities of this standard nickel solution to the tanniferous liquid until the solution no longer gives a blue-black colour with ferric chloride. The nickel solution is prepared by dissolving 2·890 grms. pure nickel sulphate, dried at 270° to 300° in boiling water, with the addition of a few drops of sulphuric acid. The solution is mixed with 100 c.c. of a 30 per cent solution of ammonium sulphate, divided into two equal parts, to one of which ammonia is added drop by drop until it takes a violet-blue colour. The two halves are then poured together and made up to 1 litre. This solution, according to the author, is not affected by glucose, glycerin, oxalic acid, alkaline succinates, and tartar, and 1 c.c. precipitates, 0·01 grm. of the tannin of galls, and 0·01497 grm. of the tannin of oak-bark. For carrying out the process Casali takes 20 grms. of the material (10 grms. or less if it contains more than 6 to 10 per cent) extracts with water at 70° to 80°, so that the filtered solution has a bulk of 100 c.c. Of this solution 10 c.c. are mixed with 15 c.c. alcohol, and the nickel solution is dropped in until a paper saturated with ferric chloride containing a little ferrous sulphate is no longer turned black-blue by a drop of the liquid. To prevent the precipitate from acting upon the paper it is covered with a slip of filter-paper, through which the liquid has to pass. M. Perret gives a process which will be found in the *Bulletin de la Soc. Chimique de Paris* (xli., p. 32). For A. Guyard's process we refer to the CHEMICAL NEWS.

Determination of Cane Sugar, Grape Sugar, and Dextrine in Mixtures.—Biard and Pellet.—The authors determine the glucose by titration with Fehling's solution. A second portion is boiled with acetic acid, which inverts the cane sugar only, and is then titrated. A third portion is completely inverted with sulphuric acid, and then titrated. The difference between the first and second titration shows the cane sugar, and the difference between the second and the third the dextrine.

Influence of Bone-Black in Determinations of Sugar.—L. Marot.—The quantity of sugar absorbed does not depend on the concentration of the solution, nor, beyond a certain point, upon the duration of the operation.

Analysis of Wine.—W. Lenz.—A conspectus of processes which do not admit of useful abridgment.

Determination of the Hardness of Water.—G. Loges.—To avoid shaking up the water with the soap solution, the author forces a current of air in through a brass tube which terminates in a ball perforated with a great number of fine holes.

Analysis of Tungsten-Steel and Iron.—Schneider and Lipp.—The authors place the sample under water and add gradually twice its weight of bromine; it is then heated gently, mixed with nitric acid, dried, the operation repeated, and finally dissolved in dilute nitric acid. To separate ferric oxide contained in the residual silica and tungstic acid, it is fused with soda, lixiviated with water, the solution evaporated to dryness with nitric acid, and the residual mixture of silica and tungstic acid is weighed. For their separation they are melted with five parts of acid potassium sulphate until the visible flocks of tungstic acid have entirely disappeared. The melt, when cold, is treated with a dilute solution of ammonium carbonate, when tungstic acid dissolves and silica remains behind. The weight of the latter, subtracted from the total weight of both acids, gives the weight of the tungstic acid. The determination of the carbon in tungsten steel is effected by treatment with copper chloride, and igniting the residue in a current of oxygen. The carbon of tungsten iron is determined by direct combustion in oxygen.

Determination of Water in Potato Starch.—Saare.—The author weighs out 100 grms. of the sample, washes it into a 250 c.c. flask, fills up to the mark at 17·5°, weighs, and deducts the weight of the dry empty flask. From the difference the moisture is calculated by means of a table.

Test for Gelatin.—Vogel.—The author adds ammonia to a 10 per cent solution of silver nitrate till the precipitate is re-dissolved, and mixes this liquid with an equal volume of the solution of the gelatin under examination. If the gelatin is impure, the mixture takes a yellow or even a brown colour.

Analysis of Plating Baths.—G. Buchner.—The author determines potassium carbonate by diluting, precipitating with calcium chloride, and immediately filtering the precipitate of calcium carbonate. The silver is determined by precipitating 10 c.c. of the bath with ammonium sulphide, collecting the precipitate, washing, dissolving the moist precipitate in dilute nitric acid, making up to 100 c.c., and titrating 20 c.c. on Volhard's method. The free potassium cyanide is determined in 10 c.c. of the bath, which are diluted with 100 c.c. water and titrated with centinormal silver solution. The combined potassium cyanide corresponds to the quantity of the silver.

Analysis of Cattle Foods.—S. M. Babcock.—From the "Report of the New York Agricultural Experimental Station."

Behaviour of Glacial Acetic Acid with Fats and Lubricating Oils.—E. Valenta.—The author gives his results in the form of a table.

Determination of Urea and Total Nitrogen in Iron.—H. Braun.—This paper does not admit of useful abstraction.

Detection of Mercury in Urine.—J. Nega.—A modification of the process of Ludwig and Fürbringer.

Polarimetric Determination of Sugar in Urine.—Worm-Muller.—A comparison between the results of polarisation by the Soleil-Ventzke's process, and of titration with Fehling's solution. The differences were considerable, amounting in several cases of diabetes to 1 to 2·4 per cent.

Occurrence of Levulose in Urine.—J. Seegen.—The author has succeeded in demonstrating this disputed phenomenon.

Detection of Morphine in Urine.—R. Schneider.—The author finds the Kauzman-Dragendorf method satisfactory.

The Use of Magnesium Sulphate for the Separation and Determination of Albumen and Globuline.—Burckhardt has found this method to give trustworthy results.

Behaviour of Urine with Diazo-benzol-sulph-acid.—H. Spiethoff.—The solution of this acid used for Ehrlich's test (xxii., p. 301, and xxiv., p. 152) must not be more concentrated than was recommended by Ehrlich.

The Colouring Matter of Blood.—H. Struve.—The author contends that oxyhæmoglobine is merely a globuline permeated with colouring-matter.

The Equivalent of Molybdenum.—Von der Pfordten maintains that the methods of determination hitherto employed are open to objections, and that the question is still undecided.

MISCELLANEOUS.

The Professorship of Chemistry, Royal School of Mines, South Kensington.—Professor Thorpe, of Leeds, has been appointed to the chair of Chemistry at this institution.

Honours to a Chemist.—We are happy to inform our readers that Dr. C. A. Cameron, who is so favourably known to them as a sanitary and an agricultural chemist, has been elected President of the Royal College of Surgeons for Ireland, and has almost simultaneously been knighted.

The Metallurgy of Iridium.—Our readers will, of course, remember that in our issues for January 2, 9, and 16 of the present year we inserted a most valuable paper on the "Fusion, Casting, Dephosphorising, and Plating of Iridium," from the pen of Mr. Nelson W. Perry, E.M. In this memoir, Mr. John Holland, of Cincinnati, is mentioned as the inventor of the process of fusing and working iridium by the aid of phosphorus, which is then subsequently, where necessary, eliminated. Mr. N. W. Perry's paper called forth a short and courteous letter from Messrs. Johnson, Matthey, and Co. (Chemical News, February 6, p. 71), for which we must refer our readers to that number. To this letter, which fills only half a column, Mr. N. W. Perry replied in a communication of about five times the length. As his letter was obviously too long for insertion we summarised what seemed to us its principal points in our issue for May 1 (p. 214), and hoped that the controversy would thus come to an end, unless Messrs. Johnson, Matthey, and Co. should choose to reply. To our surprise we received another long—and we regret to say an imputative—letter from Mr. Perry. This gentleman thinks "we should have granted him the same courtesy that we did Messrs. Johnson, Matthey, and Co., and published his side of the controversy in full, as we did theirs." In other words, because we gave that firm half a column of our space we should have given Mr. Perry nearly three columns! That, surely, would have been somewhat more than fair. Mr. Perry, too, urges that we selected but a single one of the points raised in his former letter, and "did not present that fairly." In justice to ourselves and to our readers we are, therefore, compelled to refer to his letter written in reply to that of Messrs. Johnson and Matthey, published in our number for February 6. Mr. Perry, after quoting a passage from Messrs. Johnson and Matthey's letter, says:—"Now as to the statement that the fusion of iridium with phosphorus was a matter of metallurgical knowledge long before such exhibit (1851) I am not, of course, prepared to deny." Now as this is the very essence of Messrs. Johnson and Matthey's contention, if Mr. Nelson W. Perry is not prepared to deny it, the ground for the present controversy is very much narrowed. He proceeds, however, "but that it was a matter of *general* metallurgical knowledge seems improbable, &c." But as Messrs. Johnson and Matthey never contend that it was a matter of such *general* knowledge this is not really to the purpose. This first point is therefore, we submit, fairly disposed of. Mr. Perry then goes on to argue, from the fact of Mr. Holland having obtained an American patent for his invention, that the method could not have been *generally* known, and enters into a comparison between the patent system of the United States and that of England. This is the more needless as the difference between the two systems is perfectly well known to all technologists in this country. But, be it known or not, it is irrelevant because Messrs. Johnson and Matthey do not assert *general* metallurgical knowledge or publication. As we said (p. 214) in the last few lines of our remarks on this subject:—"That such a method for fusing iridium was a matter of metallurgical knowledge *to a limited few* is possible, and it seems to us that such knowledge on the part of the principal workers in this metal *would not be likely to become publicly known*." Mr. N. W. Perry then goes on to quote at great length certain correspondence between Mr. Holland and Messrs. Johnson and Matthey on the subject of obtaining a supply of iridium suitable for pen-points. The samples forwarded to Mr. Holland do not seem to have suited his purpose. To this point we also referred in our comments on May 1, and, in our humble opinion, with perfect fairness. In discussing this correspondence, however, Mr. Perry calls attention to the statement of Messrs. Johnson, Matthey, and Co., that for "many years past they have succeeded in working pure iridium into rods and wire," a specimen of which wire they presented to us about three years ago. He compares this statement with an article by Mr. G. Matthey (Chemical News, vol. xxxix., p. 176) in which the writer speaks of the "brittleness and hardness of pure iridium," and that an alloy of platinum with 50 per cent of iridium he had been unable "to work up into forms other than castings beyond what he can effect by pressure when in a semi-fluid condition." But here certain questions arise:—Has Mr. N. W. Perry satisfied himself that the reputed iridium wire of Messrs. Johnson and Matthey is not pure, and what are the properties of an absolutely pure iridium?

The phospho-iridium of the American Iridium Company, according to the analyses quoted on page 20 of our present volume, contains—

Iridium	80·82
Osmium	6 95
Phosphorus	7·09
Ruthenium and rhodium	7·20
	102·06

Now, supposing the phosphorus absolutely removed by the treatment with lime described by Mr. Perry, we have still remaining, not pure iridium, but an alloy of iridium, osmium, rhodium, and ruthenium, the properties of which will presumably differ from those of absolute iridium, it being doubtless harder and more brittle. The question before us is not the validity of certain patents, but the alleged priority of observation of certain facts. If, as we should suppose, the only records of Messrs. Johnson and Matthey's use of the phosphorus process are to be found in their private books and memoranda, no documentary evidence of the kind which Mr. Holland has asked for, and which Mr. Perry fails to find, can exist. And according to British patent law the private user of any process, without publication, is no bar to such process being subsequently patented by any other person.

NOTES AND QUERIES.

*** Our Notes and Queries column was opened for the purpose of giving and obtaining information likely to be of use to our readers generally. We cannot undertake to let this column be the means of transmitting merely private information, or such trade notices as should legitimately come in the advertising columns.

Chemical Equations.—As to the mode of calculating chemical equations communicated by Mr. H. G. Madan I may remark that I have taught exactly the same for many years. I think I saw the plan first in *Nature* in 1881 or 1882.—J. H. B.

MEETINGS FOR THE WEEK

MONDAY, 22nd.—Geographical, 8.30.
WEDNESDAY, 24th.—Geological, 8.
—— Society of Arts, 4. (Anniversary).
FRIDAY, 26th.—Quekett Club, 8.
SATURDAY, 27th.—Physical, 3. "On the Specific Refraction and Dispersion of the Alums," Dr. Gladstone, F.R.S. "On a Form of Standard Daniell Cell, and its Application for Measuring Large Currents;" and "A Note on the Phenomenon of Molecular Radiation in Incandescent Lamps," Prof. Fleming.

TO CORRESPONDENTS.

Sm.—The article referred to was written thirteen years ago. The circumstances have materially altered since then, and the cultivation of the cinchona is conducted in a more scientific manner.

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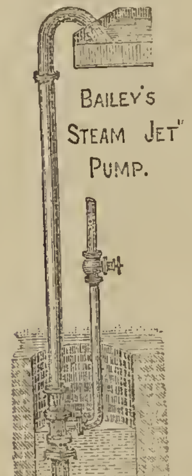

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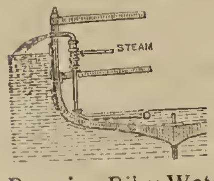

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THE CHEMICAL NEWS.
Vol. LI. No. 1335.

ON RADIANT MATTER SPECTROSCOPY.*

Part II.—Samarium.

By WILLIAM CROOKES, F.R.S.

In the concluding sentence of the Bakerian Lecture which I had the honour to deliver before the Royal Society, May 31st, 1883, I said that the new method of Radiant Matter Spectroscopy there described had given me not only spectrum indications of the presence of yttrium as an almost invariable, though very minute, constituent of a large number of minerals, but had likewise revealed signs of another spectrum-yielding element. I stated that I had repeatedly seen indications of another very beautiful spectrum characterised by a strong red and a double orange band.

Elimination of Mercury Vapour from Vacuum Tubes.

It is much more difficult than is generally supposed to keep mercury vapour from diffusing into the experimental tubes.

The following plan answers perfectly so far as my experiments have yet gone:—Sulphur is first prepared by keeping it fused at a high temperature till bubbles cease to come off, so as to get rid of water and hydrogen compounds. It is then allowed to cool, and is pounded and sifted so as to get it in the form of granules averaging a millimetre in diameter. A glass tube, a centimetre in diameter and about 2 feet long, is lightly packed for half its length with this sulphur, and next about 2 inches of iodide of sulphur (I_2S_2) is added, and the rest of the tube is then filled up with sulphur. Ignited asbestos is packed in at each end to keep the sulphur from blowing out whilst the vacuum is being made, or from being sucked through when air is suddenly let in. This contrivance entirely keeps mercury vapour from passing through, since the iodide of sulphur holds its iodine very loosely, and fixes the mercury in the form of non-volatile red iodide. A glass tube containing finely divided copper must follow in order to keep sulphur out. With this blockade interposed between the pump and experimental tubes I have been unable to detect mercury vapour in any of the tubes, whether in the cold or on heating them.

The "Orange Band" Spectrum.

Since the date of my last paper I have devoted myself to the task of solving the problem presented by the double orange band first observed in 1881. With the yttrium experience as a guide it might be thought that this would not be a difficult task, but in truth it helped me little beyond increasing my confidence that the new, like the old, spectrum was characteristic of an element. The extreme sensitiveness of the test is a drawback rather than a help. To the inexperienced eye one part of "orange band" substance in ten thousand gives as good an indication as one part in ten, and by far the greater part of the chemical work undertaken in the hunt for the spectrum-forming element, has been performed upon material which later knowledge shows does not contain sufficient to respond to any known chemical test.

Chemistry, except in few instances, as water-analysis and the detection of poisons, where necessity has stimulated minute research, takes little account of "traces"; and when an analysis adds up to 99·99, the odd 0·01 per cent is conveniently put down to "impurities," "loss," or "errors of analysis." When, however, the 99·99 per cent constitutes the impurity and this exiguous 0·01 is the precious material to be extracted, and when, moreover, its chemistry is absolutely unknown, the difficulties of the problem become enormously enhanced. Insolubility as ordinarily understood is a fiction, and separation by precipitants is nearly impossible. A new chemistry has to be slowly built up, taking for data uncertain and deceptive indications, marred by the interfering power of mass in withdrawing soluble salts from a solution, and by the solubility of nearly all precipitates in water or in ammoniacal salts, when present in traces only. What is here meant by "traces" will be better understood if I give an instance. After six months' work I obtained the earth didymia in a state which most chemists would call absolutely pure, for it probably contained not more than one part of impurity in five hundred thousand parts of didymia. But this one part in half a million profoundly altered the character of didymia from a radiant-matter-spectroscopic point of view, and the persistence of this very minute quantity of interfering impurity entailed another six months' extra labour to eliminate these final "traces" and to ascertain the real reaction of didymia pure and simple.

Chemistry of the Orange Band forming Substance.

At first it was necessary to take stock, as it were, of all the facts regarding the supposed new substance, provisionally termed x, which had turned up during the search for the orange band. In the first place x is almost as widely distributed as yttria, frequently occurring with the latter earth. It is almost certainly one of the earthy metals, as it occurs in the insoluble oxalates, in the insoluble double sulphates, and in the precipitate with ammonia. It is not precipitated by sodic thiosulphate, and moreover it must be present in very minute quantities, since the ammonia precipitate is always extremely small, and as a rule x is not found in the filtrate from this precipitate.

At this stage of the enquiry the chemical reactions of x were much more puzzling than with yttria. At the outset an anomaly presented itself. The orange band was prone to vanish in a puzzling manner. Frequently an accumulation of precipitates tolerably rich in x was worked up for purposes of concentration, when the spectrum reaction suddenly disappeared, showing itself neither in precipitate or filtrate; whilst on other occasions, when following apparently the same procedure, the orange band became intensified and concentrated with no apparent loss. The behaviour of the sulphate to water was also very contradictory; on some occasions it appeared to be almost insoluble, whilst occasionally it dissolved in water readily.

Is "X" a Mixture?

A very large series of experiments which need not here be described in detail resulted ultimately in establishing the remarkable fact that the x I sought was an earth which of itself could give no phosphorescent spectrum in the radiant matter tube, but became immediately endowed with this property by admixture with some other substance, which substance likewise by itself had no power of phosphorescing with a discontinuous spectrum.

"X" in Cerite.

In the corresponding yttrium research I was aided materially by the fact that the sought-for earth did not give an absorption spectrum. This enabled me to throw out a large number of obscurely known elements, and I therefore early endeavoured to ascertain whether the supposed new earth, x, did or did not give an absorption spectrum. Gradually it was noticed that whenever the didymium absorption bands were strong the orange band spectrum was also particularly brilliant. Moreover, amongst the earths previously enumerated as mixed with lime in the quest for x, I have mentioned that some of them gave the orange band spectrum with increased intensity; the earths of the cerium group were the most

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* Abstract of a Paper read before the Royal Society, June 18, 1885.

noteworthy, and these considerations made it probable that here would be found the location of x.

Analysis of Cerite.

The cerium group consists of cerium, lanthanum, didymium, and samarium.

The first necessity was to get the earths ceria, lanthana, and the mixture hitherto called didymia, in a pure state, for my so-called pure earths of this group all showed the orange band in more or less degree.

The separation from each other of ceria, lanthana, didymia, and samaria is a most laborious process, and the amounts of these earths, obtainable in anything like a pure state, is small, compared with the mass of material worked up. Full particulars are given in the paper as to the method adopted to obtain each of them in a state of purity.

Ceria.

The ceric oxide obtained was almost pure white. A considerable thickness of a strong solution did not show a trace of absorption spectrum. The atomic weight of the metal was taken and yielded the number 141·1.

The ceric oxide gave no orange band spectrum in the radiant matter tube, either with or without the addition of lime.

Lanthana.

Lanthana is more difficult to purify than ceria. Long after the lanthana appeared pure, it gave in the radiant matter tube a good orange band spectrum when mixed with lime and treated as usual, although without lime it gave no spectrum. Ultimately, however, a lanthana was obtained which, mixed with lime and treated in the usual manner, gave no orange band spectrum whatever. This lanthana was snow-white, and had an atomic weight of 138·3.

Didymia.

The earth formerly called didymia is now known to be a mixture of didymia and samaria, and systematic operations were now commenced with the object of obtaining the didymia and the samaria in a state of purity.—that is to say, in such a condition that one of them should show no orange band spectrum at all, whilst the other should give the spectrum in its highest degree of intensity.

I commenced the purification of didymia in the latter part of the year 1883, and the operations have been going on since almost daily in my laboratory. At intervals of some weeks the didymia in the then stage of purification was tested in the radiant matter tube, a little lime having previously been added to bring out the discontinuous phosphorescence. During the first month or two the intensity of the orange band spectrum scarcely diminished. After this it began to fade, but the last traces of orange band were very stubborn, and not till the last few weeks could I obtain a didymia to show no trace of the orange band spectrum; and this result has not been accomplished without sacrifice. My 1000 grammes have dwindled away bit by bit, till now less than half a gramme represents all my store.

Samaria.

The foregoing experiments left little doubt that x, the orange-band-forming body, was samarium; the last problem was, therefore, to get this earth in a pure state. The general plan of operations was the same as I adopted in getting didymium free from samarium, only attention was now directed to the portions richest in samarium which had been formerly set aside. The colour of samaria, as pure as I have been able to prepare it, is white with the faintest possible tinge of yellow. The absorption spectrum of samarium salts is much more feeble than the spectrum of didymium.

The Phosphorescent Spectrum of Samarium.

Pure samaric sulphate by itself gives a very feeble phosphorescent spectrum. When, however, the samaria is mixed with lime before examination in the radiant matter tube, the spectrum is, if anything, more beautiful than that of yttrium. The bands are not so numerous, but the contrasts are sharper. Examined with a somewhat broad slit, and disregarding the fainter bands, which require care to bring them out, the spectrum is seen to consist of three bright bands,—red, orange, and green,—nearly equidistant, the orange being the brightest. With a narrower slit the orange and green bands are seen to be double, and on closer examination faint wings are seen, like shadows to the orange and green bands.

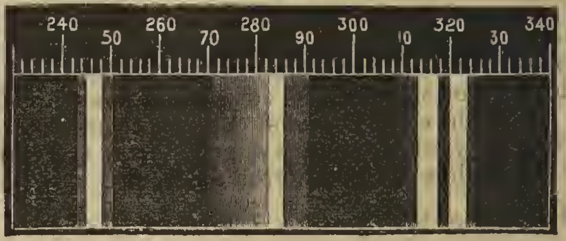
Preliminary experiments had shown me that lime was one of the best materials to mix with samaria in order to bring out its phosphorescent spectrum, but it was by no means the only body which would have the desired effect.

The samarium spectra, modified by other metals, may be divided into three groups. The first group comprises the spectra given when glucinum, magnesium, zinc, cadmium, lanthanum, bismuth, or antimony is mixed with the samarium. It consists simply of three coloured bands, red, orange, and green; as a typical illustration I will select the lanthanum-samarium spectrum (Fig. 1).

Fig. 1.

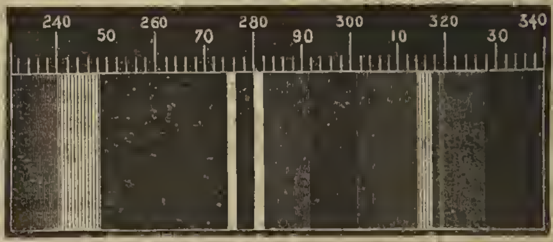
The second type of spectrum gives a single red and orange and a double green band. This is produced when barium, strontium, thorium, or lead, are mixed with samarium. The lead-samarium spectrum (Fig. 2) illustrates this type.

Fig. 2.



The third kind of spectrum is given by calcium mixed with samarium. Here the red and green are single, and the orange double. Aluminium would also fall into this class were it not that the broad ill-defined green band is also doubled. The calcium-samarium spectrum (Fig. 3) is a good illustration of this type.

Fig. 3.

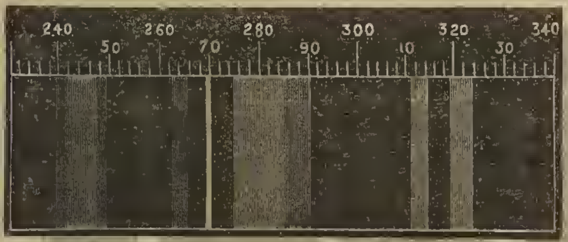


Mixed Samarium and Yttrium Spectra.

It was interesting to ascertain what spectrum a mixture of samarium and yttrium would give. A mixture of ninety parts of samaria to ten of yttria was treated with sulphuric acid and then ignited, and afterwards examined in the radiant matter tube. The result was as remarkable as it was unexpected. Not a trace of the yttrium spectrum could be detected. The powder phosphoresced with moderate intensity, but the spectrum was almost the facsimile of that given by pure samaric sulphate, except that the sharp orange line, which in the spectrum of pure samaric sulphate is only just visible, had gained sufficiently in intensity to be measurable, and was found to lie at 2693, on the $\frac{1}{\lambda^2}$ scale. A large number of experiments were next tried on mixtures of samaria and yttria in different proportions, and the results are given in full in the paper.

Up to mixtures of 43 parts samaria and 57 parts yttria the spectrum nearly resembled the lead-samarium spectrum. Not a band of the yttria spectrum could be detected, and the brilliant orange line stood out sharply in the whole series. This spectrum is represented in Fig. 4.

FIG. 4.



After that proportion had been reached a change rapidly came over the spectra, and in the next trial mixture—samaria 35, yttria 65—the only indication of the samarium spectrum that could now be found was seen in the two faint green bands next to the citron line of yttria, and the new orange line, which shone out as brightly and sharply as ever.

It will be remarked that a sudden change of spectrum occurs between very narrow limits of mixture.

The spectrum of a mixture of 44 parts samaria and 56 parts yttria, except for the orange line, is the pure samarium spectrum. The spectrum of 42 samaria and 58 yttria is built up of some of the component bands of the spectrum of each earth; whilst the spectrum of 39 samaria and 61 yttria is almost a pure yttria spectrum, the sharp orange line running across them all.

The Delicacy of the Spectrum Test for Samarium.

Experiments were now commenced with the object of getting some approach to a quantitative estimate of how small a quantity of samarium could be detected.

A mixture was first made in the proportion of one part samarium to 100 parts of calcium. The spectrum is very brilliant, and but little inferior in sharpness to the spectrum given by a 50 per cent mixture.

A mixture was now prepared containing 1 part of samarium to 1000 parts of calcium. Very little difference can be detected between the spectrum of this mixture and that of the last. The bands are, however, a little less sharp.

A mixture containing one part of samarium to 10,000 parts of calcium was now tested. The bands are now getting fainter, the second green band is fading out, and the continuous spectrum of calcic sulphate is getting brighter.

The next mixture tried contained 1 part of samarium in 100,000 parts of calcium. Here the green is almost gone, being overshadowed by the continuous spectrum of calcium which has spread over it. The red band has likewise almost disappeared in the greater brightness of the continuous red of the calcic spectrum. The double orange band is still very prominent, and the black space, 2942, between it and the green is very marked.

The next mixture, 1 part of samarium to 500,000 parts of calcium, gives a spectrum which is fainter than the last, but the orange bands are still distinctly visible. The black space between the yellow and green is strongly marked, but narrower than before.

A mixture of one part of samarium in 1,000,000 parts of calcium was next subjected to experiment. In this the samarium spectrum is very feeble, and the orange bands are only to be seen with difficulty. Now the most striking characteristic of this spectrum is the black space which still cuts out the greater portion of the yellow.

A mixture of one of samarium in 2,500,000 parts of calcium was now taken. In the spectrum shown by this mixture the bands of samarium have entirely gone, and its presence now is apparent only by the darkening in the yellow portion of what otherwise would be a continuous spectrum.

The calcium phosphorescent spectrum by itself is continuous, with no break, lines, or bands in it.

The Anomalous Line $\frac{1}{\lambda^2}$ 2693.

On several occasions I have spoken of an orange line, 2693, which by its brilliancy and sharpness is a prominent object in most of the samarium-yttrium spectra. With pure samaric sulphate it is exceeding faint. With samaria containing five per cent of yttria it is very little brighter; with 10 per cent of yttria it gains a little; with 15 per cent it is brighter still, and with a mixture of 80 parts samaria and 20 parts yttria it is at its maximum intensity. It continues to be the most striking feature in the spectra of the various mixtures of samaria and yttria until the proportion becomes samaria 3, yttria 97, when it begins to get less bright, and only when pure yttria is reached does it altogether vanish.

It is noteworthy that so long as this bright line is a component of the spectrum, the other bands manifest decidedly less intensity, and many of them are suppressed. The profound modification in the spectra of samaria and yttria developed by their mixture is, I believe, without precedent in spectrum analysis. It is difficult to realise the character of the modification which converts somewhat faint diffused bands into one intensely sharp and brilliant line.

One important lesson taught by the many anomalies unearthed in these researches is, that inferences drawn from spectrum analysis *per se* are liable to grave doubt, unless at every step the spectroscopist goes hand in hand with the chemist. Spectroscopy may give valuable indications, but Chemistry must after all be the court of final appeal.

Obituary.—Chemists in this country will hear with regret of the death of Georges Witz, of Rouen, which took place on the 17th inst. The importance of his contributions to the chemistry of cellulose has been fully recognised. M. Witz has been struck down at the early age of 48 in the midst of an active and useful career, reflecting honour upon the Société Industrielle of his native town, of which he was a conspicuous member.

Nickel Crucibles.—These appliances are recommended as being less costly than crucibles of silver and permitting the use of a much higher temperature. The annual production of copper in the entire world is estimated at upwards of 200,000 tons.—*Les Mondes*, No. 14, 1885.

Detection of Albumen in Icteric Urine.—Biliverdine present in urine is precipitated on the addition of an acid or the application of heat. P. Grocco gives distinctive reactions. If the urine is free from albumen it is not rendered turbid after acidulation and filtration either by picric acid or potassium mercury iodide, or potassium ferrocyanide. The precipitate formed by phospho-tungstic acid gives on decomposition with alkali, and on addition of a little copper sulphate, no red or violet colour.—*Zeit. f. Anal. Chem.*, Part 2, 1885.

A CATALOGUE OF CHEMICAL PERIODICALS.*

By H. CARRINGTON BOLTON, Ph.D.,
Professor of Chemistry in Trinity College, Hartford, Conn.

(Continued from p. 291).

68. Chemist (The); or, Reporter of Chemical Discoveries and Improvements and Protector of the Rights of the Chemist and Chemical Manufacturer. Edited by Charles Watt and John Watt. 6 vols., 8vo. London, 1840-'45.

Continued under the title:

[a] Chemist (The); or, Reporter of Discoveries and Improvements in Analytical, Manufacturing, and Agricultural Chemistry. Edited by John Higgs Newton. 1 vol. (vii.), 8vo. London, 1849-'48.

Continued under the title:

[b] Chemist (The). A monthly journal of chemical philosophy and of chemistry, applied to the arts, manufactures, agriculture, and medicine, and record of pharmacy. Edited by John and Charles Watt. New series. 4 vols., 8vo. London, 1849-'53.

Continued under the title:

[c] Chemist (The). A monthly journal of chemical and physical science. Edited by John and Charles Watt. New series. 5 vols., 8vo. London, 1854-'58. ||

69. Chemist (The) and Druggist. A monthly trade circular. 12 vols., 8vo. London, 1859-'71.

Continued under the same title:

[a] 13 vols. (xiii.-xxv.), 4to. London, 1872-'84+

70. Chemists' and Druggists' Advocate. London, 1873-'80.

71. Chemist (The) and Meteorological Journal. July 8th to Dec. 9th, 1826. John R. Cotting, Editor. Amherst, Mass. 8vo, *n. d.*

72. Chemists' (The) Desk Companion for 1865-['66]. The Year-Book of Pharmacy. A practical summary of researches in pharmacy, materia medica, and pharmaceutical chemistry. Edited by Chas. Wood and Chas. Sharp. 2 vols., 8vo. London, 1865-'66.

Cf. Year Book of Pharmacy.

73. Chemists' (The) Journal. 6 vols. London, 1880-82+

Chevallier, Fee, Guibourt, Julia-Fontenelle, Laugier, Orfila, [etc.] *See* Journal de chimie médicale.

Chevreul, E.
See Annales de chimie et de physique.

Chiappero, F.
See Giornale di farmacia, chimica, [etc.].

Chicago College of Pharmacy.
See Pharmacist and Chemical Record.

74. Chimiste (Le). Journal de chimie appliqué aux arts à l'industrie et à l'agriculture; publié par Henri Bergé. 5 vols., 8vo. Bruxelles, 1865-'69.

75. Chimiste (Le) journal des distillateurs. Organe spécial de la chimie appliquée à la distillation et à la conservation des vins et spiritueux. Rédacteur en chef: Simon. 4to. Paris, 1859, '60.

Columbian Chemical Society, Philadelphia.
See Memoirs of the—.

76. Comptes-Rendus Hebdomadaires des séances de l'Académie des Sciences, publiés conformément à une décision de l'Académie en date du 13 Juillet, 1835, par MM. les Secrétaires perpétuels. 98 vols., 4to. Paris, 1835-'84+

Supplément aux Comptes-Rendus hebdomadaires des séances de l'Académie des Sciences, publiés conformément á une décision de l'Académie en date du 13 Juillet, 1835, par MM. les Secrétaires perpétuels. 2 vols., 4to. Paris, 1856 *and* 1861.

Table génerale des Comptes-Rendus hebdomadaires des séances de l'Académie des Sciences, publiés par MM. les Secrétaires perpétuels, etc. Tomes i.-xxxi., Août 1835 à 30 Décembre 1850. 1 vol., 4to. Paris, 1853.

(To be continued.)

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* Advance-proofs from the *Annals of the New York Academy of Sciences.*

METHODS OF ANALYSING SAMARSKITE

AND THE OTHER COLUMBATES CONTAINING EARTHY OXIDES, BY THE AGENCY OF FLUORHYDRIC ACID; AND OF DISSOLVING COLUMBITE AND TANTALITE BY THE SAME ACID.—ON THE SEPARATION OF THORIA FROM THE OTHER OXIDES.—THE QUANTITATIVE ESTIMATION OF DIDYMIUM OXIDE IN ITS MIXTURES WITH OTHER EARTHY OXIDES.*

By J. LAWRENCE SMITH.

(Concluded from p. 291.)

Earths from Samarskite.

As it has been necessary to use letters to indicate the various groups of constituents of this mineral, they will be stated in a list for easy reference:—

(*a*) The portion of samarskite soluble in fluorhydric acid.
(*b*) The portion of samarskite insoluble in fluorhydric acid.
(*c*) The mixed oxalates of the earths from samarskite.
(*d*) The earthy oxides insoluble or dissolved with difficulty by the sulphate of potassium or sodium.

From the time that samarskite was discovered until I undertook the examination of the mineral as it was found in Mitchell county, N.C., the earths from the ignited oxalates were considered to be the oxides of the cerium group and yttria group, and in my researches, made in 1876 and 1877, while I referred to one of these oxides as cerium oxide, in a footnote† I stated that there were grounds for belief that the oxide so-called was not cerium oxide, as it was completely soluble in a very dilute solution of nitric acid.

A little later, by repeated precipitation of this oxide (as prepared from samarskite) with sodium sulphate I obtained an oxide, the sulphate of which is absolutely insoluble in a concentrated solution of the sulphate. The oxide of this was completely soluble in very dilute nitric acid. In many respects it resembled cerium oxide. Among them it did not furnish any absorption ray in the spectrum, but its complete solubility in very dilute nitric acid was a marked distinction between it and cerium oxide. For this reason I considered it a new oxide, and called it mosandrum. The atomic weight of the oxide was made out to be 109 (O = 16).

M. Marignac, however, as well as Prof. Delafontaine, was inclined to regard the oxide as terbia. The properties of this latter earth were never clearly understood, yet as far as I have been able to make them out I considered it to differ from what I had called mosandrum. Not having any absorption ray, it is not so easy to decide upon as most of the earthy oxides.

The study instituted upon the earths coming from samarskite opened a new field of investigation upon the earths of the cerium and yttrium groups, especially among those which gave marked and decided absorption rays. As yet they cannot be separated in a pure state in sufficient quantity for a complete chemical study, at least so far as my information at the present time goes.

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* From "Original Researches in Mineralogy and Chemistry," by J. Lawrence Smith, Membre Correspondant de l'Institut de France (Academie des Sciences), &c. Printed for Presentation only. Edited by J. B. Marvin, B.Sc., M.D. Louisville, Ky. 1884.

† *American Journal of Science*, May, 1877.

Prof. Delafontaine, of Chicago, has done some excellent work on these earths, among which he considers that he has discovered two metals that are new, phillipium[*] and decipium. In regard to the first, the spectroscopic and other characteristics are well defined, so much so that those chemists and physicists who have examined it, as MM. Marignac, Soret, and Lecoq de Boisbaudran, have no doubt upon the subject. As regards decipium,[†] the spectroscopic examination of Soret and Lecoq de Boisbaudran has not as yet furnished us with any positive decision, as far as my information extends at the present time; M. Delafontaine, however, feels satisfied about it.

In addition to the above, M. Marignac has separated another,—working, however, on gadolinite and euxenite,—which he calls ytterbium,[‡] and L. F. Nilson another, which he calls scandium,[‖] and believes to be associated with the ytterbium of Marignac. It is determined by spectroscopic examination of a somewhat complicated nature. I would here state that most of these new earths have only been made out by a very small quantity, sometimes less than a gramme, the spectroscopic work being done by the most skilful observers.

The use of the spectroscope in studying the earths requires great care, and sometimes the presence of a very minute quantity of some foreign substance may lead to wrong conclusions. Thus the presence of traces of uranium caused Sorby to mistake zirconia for a new oxide that he called jargonia; and some similar cause induced Delafontaine[§] to consider that there was a marked difference between the didymium oxides of cerite and samarskite, didymium oxide of cerite being a mixture of different earths. Soret,[¶] however, showed that the didymium oxide from samarskite, as furnished him by Marignac, was the same as that from the oxide from cerite. Lecoq de Boisbaudran came to the same conclusion from the oxide I had furnished him as coming from samarskite. A still more curious fact is that, in some experiments I made in connection with Lecoq de Boisbaudran, a peculiar treatment of pure didymium oxide by acids so altered the most important absorption ray furnished in the spectrum of that earth as to destroy its characteristics.[**]

Up to the present time the following earths have been found in samarskite. I give the list as made out by Delafontaine, with the exception of mosandrum, which he does not recognise:—

Yttria
Erbia
Terbia
Philippia
Decipia
Thoria
Oxide didymium
Oxide cerium
Mosandria

The proportion of each of these earths in the 14 per cent of earths it is impossible to state. As regards the thoria it is about 0·50 of the mineral. The oxides of cerium and didymium exist only in traces.

The method of separating most of these earths is by fractional precipitation with oxalic acid, or by some alkali as employed by myself. Operating with the ignited nitrate is used in other instances, but in whatever manner the separation is attempted it is attended with difficulty, and greatly reduces the quantity of the residuary oxide which is sought for.

It is the insoluble precipitate *d* that furnishes the difficult problem of quantitative analytical chemistry, and several earths of yet undefined character have been more or less perfectly separated. I will give some of my own labours in that direction.

Many interesting results have been worked out, by Marignac, of Geneva, and Delafontaine, of Chicago; but the slow, tedious processes that have to be employed will delay those labours very much.

The method by which I made some imperfect operations on the oxalate c *is as follows*:—The powder is dried, ignited, and weighed. It has a pale yellow colour, and consists of several earthy oxides. It is completely soluble in dilute or strong nitric acid. The solution of it in the acid is evaporated to the consistency of thick syrup, thus driving off nearly all the free acid. To this syrupy mass, before it solidifies,[*] about 50 c.c. of a concentrated solution of sulphate of potassium or sodium (lately I have used the sodium salt altogether) are mixed into the mass. It gives at first a clear solution. To this is added three or four grammes of small crystals of the sulphates; the whole stirred frequently, and allowed to stand for twenty-four hours. A precipitate soon begins to form, and at the end of the time is quite abundant. It is now thrown into a filter and thoroughly washed with a concentrated solution of potassium or sodium sulphate; but at no time will the filtrates be entirely free from a trace of the insoluble double sulphate. This precipitate is called *d*. The filtrate is supposed to contain yttria and erbia. To it is added oxalic acid or ammonium oxalate, the precipitated oxalate burnt, re-dissolved and re-precipitated[†] by the oxalate, then burnt, and after very thorough ignition, weighed. This oxide is then dissolved in dilute sulphuric acid, evaporated carefully to dryness, and heated nearly to red-heat, until its weight is constant. This is noted, and from the weight of the oxide and that of its sulphate the relative proportion of yttria and erbia is estimated by the formula of Bahn and Bunsen,—

$$x = 4{\cdot}9806\,a - 2{\cdot}4540\,b.$$

x = the erbia contained in a; the oxides, which give b, the sulphates.[‡] The first precipitate by the sodium sulphate, washed with a solution of the same, is dissolved in hydrochloric acid, and first precipitated as oxalates, then changed into oxides by ignition. It is in this oxide that I searched for mosandrum by repeated precipitation with sodium sulphate and re-conversion into oxides, when I obtained an oxide as dark as cerium oxide, dissolved in minute quantity in sodium sulphate and perfectly soluble in very dilute nitric acid, after thirty minutes' contact.

The insoluble double sulphates *d* precipitated from the solution of the earths may contain any or all of the other cerium oxides and thoria. This is dissolved in water containing a little chlorhydric acid by the application of heat. The solution is then nearly neutralised by ammonia and precipitated by oxalic acid or oxalate of ammonia, the precipitate is burnt, re-dissolved in nitric acid, and re-precipitated by the oxalate, which is well burnt and weighed.

This was originally supposed to be the cerium group of earths; but when rubbed up with a little water it is completely dissolved[‖] in dilute nitric acid (1 acid to 100 water) in from fifteen to thirty minutes, showing the absence of cerium oxide, or, if present, only to the extent of a mere trace.

To test this fact still farther, I precipitated the earth from its nitric acid solution by caustic soda, adding just enough to make the solution alkaline, then added 3 to 4 grms. of caustic soda, and adding water enough to make the mixture 50 c.c., it is quite thick from the gelatinous precipitate. A stream of chlorine gas is now passed slowly through the mixture for two or three hours, in the manner recommended by M. Mosander for separating cerium oxide from its associated earths. But none of the indications of colour peculiar to cerium oxide are manifested, but all the oxides are taken into solution except a

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[*] *Comptes Rendus*, 1878, lxxxvi., 559.
[†] *Ibid.*, 632.
[‡] *Ibid.*, 1879, lxxxvii., 578.
[‖] *Ibid.*, 645.
[§] *Ibid.*, 1877, lxxxv., 634.
[¶] *Ibid.*, 1878, lxxxvi., 422.
[**] *Ibid.*, 1878, lxxxvi.

[*] We are supposed to be operating with 1 or 2 grms. of the mineral.

[†] This second precipitation is always necessary when we are analysing these earths and the first solution contains potash and soda.

[‡] In the use of this method of operation it was supposed that cerium oxide and yttria could be easily separated from each other by the bisulphate of potassium and sodium, and the oxides remaining in solution were yttria and erbia, but more recent research has shown its defective character, and it is no longer adapted to furnish any good method.

[‖] This is based on the supposition that there is no other oxide present.

small quantity of a white gelatinous precipitate. This precipitate was collected on a filter and washed, detached from the filter, and dissolved by means of a few drops of sulphuric acid; evaporated to dryness, heated to drive off the excess of acid, and, when dissolved in a little cold water and examined, was found to be thoria.[*] It was afterward precipitated by ammonium oxalate, burnt and weighed, and represented 0·80 per cent. This is a new and valuable method of separating thoria, which will be treated of in another part of this paper.

The fact of the absence of cerium oxide led to a thorough examination of the *d* precipitate, for the Russian variety of samarskite contains cerium. But to do this I had to make the study upon a much larger quantity of the earths than that obtained from 5 grms. of the mineral, which contain only about 4 per cent of the *d* oxides, so that what follows is based on the use of ample material obtained from several kilogrms. of the mineral.

In this large operation I did not use platinum vessels for the first treatment, but lead vessels, the decomposing vessels being of the capacity of 4 litres, and capable of working more than 1 kilogrm. at a time, and the mineral was sufficiently divided by passing it through a wire sieve with half-millimetre meshes (less than thirty minutes being required to prepare a kilogrm. for the action of the fluorhydric acid). The mineral is placed in the lead capsule, and 750 c.c. of water poured on it; then 1 kilogrm. of fuming fluorhydric acid is added by degrees, and the mixture stirred with a lead rod until the violence of the action ceases; then a second kilogrm. of acid is added and stirred in. The capsule is now placed on a water-bath and heated, with occasional stirring, for two or three hours, when the action is complete, and we proceed as already described with the 5 grms.

When the insoluble fluorides of the earth are obtained I find the following the best way of changing them to oxalates:—250 grms. of the dry fluorides are rubbed up in a mortar and placed in a platinum capsule, then 250 c.c. of concentrated sulphuric acid are added without water, the mixture stirred and heated over the flame until nearly dry, and, after cooling, dissolved in water and uranium oxide, farther oxidised by nitric acid. After filtration the whole is diluted to about 5 litres, boiled by a current of steam, nearly neutralised, and then precipitated by 225 grms. oxalic acid dissolved in 1 litre of water. The oxalates thus obtained are operated with as already described for the separation of yttria, using either potassium sulphate or sodium sulphate. The latter has certain advantages in large operations. The thoria of the earths is with that part which is difficultly soluble in sodium sulphate.

Separation of Thoria.

The separation of this earth from the others with which it is usually associated is attended with more or less difficulty and uncertainty. These earths are of the cerium group, for the concentrated solution of potassium sulphate precipitates the thoria along with these earths. One of the best methods is considered to be that by sodium hyposulphite, but the use of it did not enable me to decide upon the presence of thoria when I made the examination for my mineralogical paper on the "Columbic Acid Minerals of the United States,"[†] while the method about to be described makes it easy of detection and quantitative separation; so much so, that I am satisfied that by means of it the metal thorium will be found to be more generally diffused than it has been supposed to be.

If thoria be precipitated from a solution of any of its salts by the fixed alkalies, and the gelatinous precipitate added to a little water containing four or five times its weight of caustic potash or soda, and a current of chlorine gas passed through it for any length of time, none of the thoria will be taken into solution; and if the other earths usually associated with thoria be present, the same result will take place as regards the thoria, but all the other earths will be dissolved with the exception of the cerium oxide. These facts have been fully verified by a special set of experiments. The thoria in the samarskite was estimated in this way,[*] and no analytical result could be more satisfactory, sufficient care being taken to pass chlorine gas through the solution long after it is supposed to be saturated. Two or three hours is not too long where a half to one gramme of the mixed oxides is operated with.

Separation of the Thoria from the Mixed Earths by Ammonia.

When thoria has to be separated from a large quantity of its associate earths the chlorine method is long, and the insoluble part has to be separated and treated two or three time before complete separation is accomplished. I accomplished this by an excellent method, but one not intended to furnish quantitative results like the chlorine method.

Using, say, 50 grms. of the earths separated by the potassium or sodium sulphate, dissolve it in nitric acid somewhat diluted, and concentrate over a water-bath; add the contents of the capsule to about 3 litres of water, boil by a current of steam or otherwise, and, when in a state of ebullition, neutralise by ammonia till only a few flakes remain undissolved; then add by degrees an ammonia solution of known strength and just sufficient to precipitate 6 or 8 grms. of the oxides,[†] the solution being made to boil violently during the operation. This ebullition is continued for about five minutes. A bulky gelatinous precipitate will be formed which contains all the thoria and a little of the other oxides. This is thrown on a filter and washed. This takes place very slowly. The gelatinous precipitate is dissolved in a dilute solution of sulphuric acid, evaporated to dryness, excess of acid driven off, redissolved in cold water. By boiling and evaporation it separates in its well-known form, which, when hot, is separated from the mother-liquor. The sulphate of thorium thus obtained is not perfectly pure, but if wanted for chemical investigations it can be purified by the usual method. This separation clearly arises from the fact that the thoria is less basic than the other earths.

The filtrate from the gelatinous precipitate is treated with oxalic acid, and the precipitated oxalate dried and ignited, giving a salmon-yellow oxide that is further examined by processes to be described. The fact that these earths have only a mere trace of thoria remaining in them is established by the fact that when one grm. of them is treated by the chlorine test for thoria already described, all the oxides are completely dissolved except 4 milligrms. I, then, recommend this method as one likely to prove useful for the purification of large quantities of the earths containing thoria in small quantity.

The earth from the thoria is of a salmon-yellow colour; its oxalate burns readily, and all tests were applied to discover lanthanum oxide, and only a very doubtful evidence of its presence was obtained. So that of the three cerium metals only didymium oxide remained to look for. A nitric acid solution gave the very well-known spectroscopic bands of that metal, but it was impossible to separate it by a chemical process. But by making use of the spectroscope I think I have approximated to the proportion mixed with the oxides in the following manner:—

Quantitative Estimate of Didymium Oxide by its Absorption-Bands.

Make solutions of the oxide of didymium of known strength, and place the solutions in tubes of uniform diameter. Vials of thin glass 1½ centims. in diameter were used. Then take the oxides to be tested, dissolving a known quantity of the oxides in a solution of nitric acid, placing

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[*] The cold solution when heated was changed into a mass of the delicate silky crystals so remarkably characteristic of thoria.

[†] *American Journal of Science*, xiii., May, 1877.

[*] As already described where treating of the absence of cerium oxide in the samarskite.

[†] In the present instance I have calculated the amount on the basis of an atomic weight of the oxides of 116 ($O=16$).

in a tube of the same size as those containing the didymium salt of known strength, compare the solution in the tubes before the spectroscope with the different didymium tubes, and it will soon be seen which one of these latter gives bands corresponding in intensity with the didymium bands in the solution of oxides that are tested; and, knowing the exact proportions of oxide in the didymium tube, a good approximate result may be obtained.

I am now making an apparatus using only one solution of didymium, and simply varying at pleasure the thickness of the solution. In this way I estimate that the mixed earthy oxides of samarskite contain less than 0·25 of didymium. As regards the principal portion of the earth separated from the yttria, I consider it as an oxide, or oxide of a new earth, for I cannot reconcile my mind to the idea that it is principally terbia. One of the earths present I call mosandrum, and M. Delafontaine has separated two, phillipium and decipium.

Owing to the fact of bodily indisposition I have not been able to continue my researches on these earths.

For the complete quantitative analysis of samarskite, reference is made to labours previously made by myself and others,* with this difference, that in the earthy oxides there is 0·50 per cent of thoria, and the cerium referred to is not that oxide, but other mixed oxides.

PROCEEDINGS OF SOCIETIES.

CHEMICAL SOCIETY.

Thursday, June 18th, 1885.

Dr. H. MÜLLER, F.R.S., President, in the Chair.

MESSRS. Jos. F. Burnett and Harry M. Freear were formally admitted Fellows of the Society.

Certificates were read for the first time in favour of Messrs. William James Bell, M.A., The Manor House, Highbury, N.; Albert Ivatt, 1, Ching Villas, Mill Road, Cambridge; Edward de Souza, Rangoon; Ernest William Wiltshire, 25, Granville Park, Lewisham.

The following gentlemen were duly elected Fellows of the Society:—Messrs. Harry Haslett; Thomas Cradock Hepworth; Leonard de Koningh; Charles Langer; Arthur Richardson; James Sharp; James Pender Smith; James Spilsbury.

The following papers were read:—

49. "*On the Decomposition and Genesis of Hydrocarbons at High Temperatures. I. The Products of the Manufacture of Gas from Petroleum.*" By HENRY E. ARMSTRONG and A. K. MILLER, Ph.D.

Having carried the examination of the various products of the decomposition of petroleum effected at high temperatures, in the manufacture of oil-gas (see paper in the *Journal of the Society of Chemical Industry*, September, 1884), as far as can usefully be done with the material originally dealt with, the authors now describe their methods and results: they remark, however, that these must be regarded as little more than preliminary, and that it will be necessary to repeat the investigation on a much larger scale, and to introduce new and improved methods. The products examined are (1) the portion of the compressed gas which combines with bromine; (2) the liquid deposited during compression of the gas to about ten atmospheres; (3) the portion of the tar which is volatile in steam.

1. By far the chief constituents of the mixture of bromides obtained by scrubbing the compressed gas by bromine are ethylene bromide and crotonylene tetrabromide, $C_4H_6Br_4$; propylene and butylene bromides have also been separated from it. The gas is practically free from hydrocarbons of the acetylene series capable of producing a precipitate in an ammoniacal cuprous solution.

2. The liquid deposited during compression of the gas is a complex mixture of olefines, of hydrocarbons of the C_nH_{2n-2} series, and of benzenes. The presence in it of *normal* amylene, hexylene, and heptylene has been demonstrated by the study of the products of oxidation of the various fractions. It is saturated with crotonylene, and contains a considerable quantity of the next homologue, C_5H_8; this latter hydrocarbon has not been previously described: it boils at 45°, and yields a tetrabromide which crystallises from alcohol in long flat prisms melting at 114°. All attempts to separate a hydrocarbon having the properties of Schorlemmer's hexoylene from the fraction boiling at 80° to 82° have hitherto been unsuccessful, the statement previously made by one of the authors that this hydrocarbon was present having been based on determinations which have since been discovered to be faulty. The liquid deposited during compression of oil-gas is rich in benzene and toluene, but contains only traces of higher benzenes.

3. The steam distillate from the tar contains the less volatile hydrocarbons present in the liquid deposited during compression of the gas together with a great variety of others. It is rich in hydrocarbons which are readily polymerised by sulphuric acid; these appear to be mainly members of the C_nH_{2n-2} series, such as Schorlemmer discovered in the light oils from cannel and boghead coal, and which yield no acid higher than acetic on oxidation. The three xylenes and mesitylene and pseudocumene are present in about the same relative proportions as in ordinary coal-tar; but, in addition, the oil-gas tar contains certainly one—probably two—*higher* members of the benzene series: the amount obtained has not been sufficient, however, to permit of the precise determination of its nature. A very considerable amount of naphthalene may be separated from the tar; bezenoid hydrocarbons of higher boiling-point than naphthalene have also been obtained in small quantity. A certain, although relatively small, amount of a complex mixture of saturated hydrocarbons has also been separated from the tar: the quantity of material at their disposal has not enabled the authors to separate these to their satisfaction and in a state sufficiently approaching purity: they are inclined to believe, however, that the mixture does not consist of paraffins, but of hydrocarbons of the C_nH_{2n} series—such as form the chief constituents of Russian petroleum.

The hydrocarbons mentioned are by no means the sole constituents of the material examined, but merely those which have been proved to be present.

The theoretical conclusions to be deduced from the results are in some respects interesting. It would appear that *only normal* olefines are present, and it is also remarkable that apparently this series is not represented by terms higher than heptylene. No true acetylenes have been detected; the crotonylene obtained is either *methylallene*, $CH_3{\cdot}CH{\cdot}C{\cdot}CH_2$, or *dimethylene-ethane*,—

$$C_2H_2(CH_2)_2,$$

and from their behaviour on oxidation it is probable that the homologous hydrocarbons are closely related to it. Hence it may be inferred that in the formation of hydrocarbons of the C_nH_{2n-2} series at high temperatures from normal olefines of the formula $C_nH_{2n+1}{\cdot}CH{\cdot}CH_2$ two atoms of hydrogen are removed in such a way that the terminal $CH_3{\cdot}CH_2$ radicle in the formula becomes either $CH_3{\cdot}CH$ or $CH_2{\cdot}CH$; although the production of acetic acid on oxidation of the hydrocarbons favours the former hypothesis, it is not safe to accept it until several of the hydrocarbons of the C_nH_{2n-2} series have been isolated and more completely studied. The possibility that *saturated* hydrocarbons of the C_nH_{2n} series are among the products is especially noteworthy, although it must not be forgotten that such hydrocarbons might have been original constituents of the petroleum used in making gas.

To settle this and other questions it is proposed to prepare oil-gas from *solid* paraffin on a sufficient scale to

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* *American Journal of Science*, May, 1877.

obtain the quantity of material required for the investigation.

50. "*On the Non-crystallisable Products of the Action of Diastase upon Starch.*" By Horace T. Brown and G. H. Morris, Ph.D.

The authors first show that the previous work of one of them (Brown and Heron, *Trans.*, 1879, 596) confirmed O'Sullivan's statement that when starch is transformed by diastase, the optical behaviour and cupric reducing power of the mixed products are such as would be accounted for by the presence only of *maltose* and a non-reducing *dextrin* having a rotatory power of $[\alpha]_{j3{\cdot}86}$ 216°.

They then proceed to show that by fractionating the starch products with alcohol all the several fractions agree in giving results which can also be interpreted in terms of maltose and dextrin only; and they thus establish a criterion of purity for any portion of the starch products which can be separated, ascribing the results of other observers, where they do not conform to this rule, either to the presence of impurities or to errors of determination.

The tendency of the mixed products from any starch transformation when subsequently acted upon by malt extract at 50° to 60° is rapidly to attain a state of equilibrium, which is represented by the equation No. 8 of the series of Brown and Heron:—

$$\underset{\text{Starch,}}{10'C_{12}H_{20}O_{10}} + 8H_2O = \underset{\text{Maltose.}}{8C_{12}H_{22}O_{11}} + \underset{\text{Dextrin.}}{2C_{12}H_{20}O_{10}}.$$

The mixed products of the transformation then have a specific rotatory power of $[\alpha]_{j3{\cdot}86}$ 162·6°, and a cupric reducing power of $\kappa_{3{\cdot}86}$ 49·3, the percentage composition being maltose 80·9, dextrin 19·1.

The rapid degradation of all the higher transformations down to this point is due to the hydrolysis of the more complex polymeric dextrins to dextrins of less molecular complexity, with the simultaneous production of a corresponding amount of maltose.

After proving that the dextrins can be submitted to frequent dissolution in water, evaporation and precipitation with alcohol without being hydrolysed, the authors proceed to examine the action of malt extract upon the separated dextrins, the experiments being all carried out quantitatively. They find, when a starch transformation is separated into two or any desired number of fractional parts by means of precipitation with alcohol, that the mean maximum degrading action of malt extract upon the fractions separately is the same in amount as the possible degradation, *cœteris paribus*, of the original solution of the starch products. The degradation is measured by the amount of maltose produced, every experiment being carried out optically as well as chemically.

The authors conclude that O'Sullivan's statement that the dextrins behave differently with malt extract when isolated and when in solution with the other products formed simultaneously with them is incorrect, and that the dextrins which O'Sullivan isolated cannot be, as he supposed, the dextrins corresponding to his particular equations. This is shown by the fact that they did not yield the right amount of maltose on treatment with malt extract at the lower temperatures, and that in all transformations giving a materially higher angle for the products than 162·6°, it can be proved by fractionation with alcohol that the dextrins are not homogeneous, some belonging to a higher position and some to a lower in the polymeric series. In fact, all such transformations are of a mixed character, owing to the starch products not being simultaneously affected. Notwithstanding the fact that the reaction appears to have a tendency to be arrested at certain points corresponding to particular equations, if the malt extract is treated in various ways prior to saccharification, yet above No. 8, which is a perfectly definite one, no sharp line of demarcation can be drawn between the equations, the possible number of which must be greater the larger the size of the starch molecule.

By submitting a separated dextrin, or a mixture of dextrins, to the action of malt extract at 50° to 60°, and determining the amount of degradation experienced, it is possible to determine the actual or mean position in the polymeric series—the *actual* position if the dextrin be homogeneous, the *mean* position if it be a mixture. In this way an examination of the dextrin of a beer which has undergone the primary fermentation will indicate very approximately the angle, and hence the original percentage composition, of the starch products of the mashing process.

The authors have attempted to prepare dextrin free from reducing power by Bondonneau's cupric chloride method. They have, however, never succeeded in entirely destroying the reducing power by this method, which they condemn from the fact that it is almost impossible to avoid hydrolysing the dextrin when employing it. They have succeeded in preparing dextrins free from reducing power by treatment with alkaline mercuric cyanide, and if this process is properly performed the dextrin is obtained in the same molecular state as before purification, *i.e.*, it is not hydrolysed, but yields with malt extract at 50° to 60° as much maltose as before treatment. The specific rotatory power of the purified dextrin approximates very closely to $[\alpha]_{j3{\cdot}86}$ 216°.

The dextrins are not directly fermentable by yeast, but require first to be hydrolysed. Some species of Saccharomyces, *e.g.*, *S. ellipticus* and *S. Pastorianus*, have the power under certain conditions of hydrolysing the higher dextrins, and fermenting the maltose so produced. The *Saccharomyces cerevisiœ* of the "high fermentation" possesses this power only to a very limited extent.

When the action of malt extract upon starch paste is limited, a *third body* is always found amongst the products of transformation, besides maltose and dextrin: it is more soluble in alcohol than the dextrin, and has a specific rotatory power of $[\alpha]_{j3{\cdot}86}$ 193·1°, and a reducing power of $\kappa_{3{\cdot}86}$ 21·1, corresponding to an apparent composition of 34·6 per cent maltose and 65·4 per cent dextrin. It is completely hydrated to maltose by the action of malt extract at 50° to 60°. The authors have no doubt that this substance is identical with one prepared by Herzfeld in an impure state, and described by him as *maltodextrin*.

Although the optical and reducing properties of maltodextrin seem to indicate that it is a mixture of maltose and dextrin, the following facts conclusively forbid such an assumption:—

1. A mixture of maltose and dextrin having the same optical character and reducing power as maltodextrin is separable into its constituents by a single judicious treatment with alcohol; whereas maltodextrin is not separable into maltose and dextrin by any possible treatment with alcohol, but is dissolved and precipitated as a homogeneous substance.

2. From a mixture of maltose and dextrin it is possible by means of the *Saccharomyces cerevisiœ* of the high fermentation to ferment the maltose, leaving the dextrin untouched. Maltodextrin treated in a similar manner is unfermentable.

3. When a mixture of maltose and dextrin is submitted to the action of malt extract at 50°—60° a residue of No. 8 dextrin is always left, the amount being greater the lower in the series the dextrin is. Maltodextrin, on the other hand, is, under similar conditions, entirely converted into maltose, its amylin constituent leaving no residual dextrin.

4. Maltodextrin is slowly diffusible, and passes unaltered through the septum, whereas a mixture of maltose and dextrin is separable by dialysis.

Although maltodextrin is unfermentable by the ordinary yeast of the high fermentation, the addition of a trace of malt extract enables that form of yeast readily to ferment it by previous hydration to maltose. Maltodextrin also undergoes slow fermentation when submitted to the action of certain forms of Saccharomyces, *e.g.*, *S. ellipticus* and *S. Pastorianus*.

The composition of maltodextrin may be expressed by the formula $\left\{\begin{matrix}C_{12}H_{22}O_{11}\\(C_{12}H_{20}O_{10})_2\end{matrix}\right.$, that is, a maltose group united with two amylin or dextrin groups, each constituent group retaining its optical and reducing properties.

The authors believe that the molecule of starch cannot contain less than five times the group $(C_{12}H_{20}O_{10})_3$, and that the action of malt extract consists in a successive hydration and removal of the $(C_{12}H_{20}O_{10})_3$ group, leaving as residue a dextrin of decreasing complexity, until the last of the five ternary groups is reached, which is the dextrin of the stable No. 8 equation, and undergoes no further change except a comparatively slow hydration. The removal of the $(C_{12}H_{20}O_{10})_3$ groups is accomplished prior to their complete hydration, the ternary group being split off the dextrin residue when only one of its amylin sub-groups is hydrated, forming free maltodextrin, thus—

$$\underset{\substack{\text{One of the five}\\ \text{ternary groups}\\ \text{constituting starch.}}}{(C_{12}H_{20}O_{10})_3} + H_2O = \underset{\text{Maltodextrin.}}{\left\{\begin{array}{l} C_{12}H_{22}O_{11} \\ (C_{12}H_{20}O_{10})_2. \end{array}\right.}$$

The maltodextrin is subsequently converted into crystallisable and fermentable maltose on further action of malt extract, providing this has not previously been heated above 65°, by the fixation of the elements of two more molecules of water—

$$\underset{\text{Maltodextrin.}}{\left\{\begin{array}{l} C_{12}H_{22}O_{11} \\ (C_{12}H_{20}O_{10})_2 \end{array}\right.} + 2H_2O = \underset{\text{Maltose.}}{3C_{12}H_{22}O_{11}}.$$

The authors are engaged in a full examination of the properties of maltodextrin, an account of which they hope shortly to lay before the Society.

51. "*Decomposition of Carbonic Acid Gas by the Electric Spark.*" By H. B. DIXON, M.A., and H. F. LOWE, B.A.

Various chemists have investigated the decomposition of carbonic acid by the electric spark. Experiments having shown that no explosion is propagated by a spark in a mixture of carbonic oxide and oxygen dried by standing over anhydrous phosphoric acid, it seemed of interest to repeat the experiments on the decomposition of carbonic acid when dried in a similar manner. Carbonic acid dried over anhydrous phosphoric acid was submitted to a series of induction sparks in a eudiometer by means of a chain composed of short pieces of platinum fused into small glass bulbs. The amount of decomposition varied from time to time, approaching no fixed limit. Similar results were found on introducing a Leyden jar into the secondary circuit of the Ruhmkorff, but the amount of decomposition was less.

On passing a series of induction sparks through a dried mixture of carbonic oxide and oxygen partial combination gradually took place, but no fixed limit was reached.

Two similar eudiometers were prepared and fitted with wires made of an alloy of platinum and iridium, each wire ending in a bulb about 2 m.m. in diameter. The bulbs were brought to the same distance apart in the two tubes. On bringing an equal volume of dried carbonic acid into the two tubes, and sending a series of sparks from one Ruhmkorff coil through both tubes at the same time, the gases in the two vessels were found to be equally affected, their volumes varying exactly together so long as the pressure was kept the same in the two tubes. The more feeble the spark the greater was the decomposition of the carbonic acid found to be.

When 100 volumes of dried carbonic acid were brought into one tube, and 150 volumes of a dried mixture of carbonic oxide and oxygen were brought into the other, and a series of sparks were passed through both from the same coil, the volume of carbonic acid increased, and the volume of carbonic oxide and oxygen diminished until after some hours they became equal. On a further prolonged passage of the spark the two volumes altered together, sometimes increasing and sometimes diminishing, as the nature of the spark varied.

A coil of fine platinum wire was heated by an electric current to whiteness in dried carbonic acid. No permanent alteration of volume was produced. When a similar coil of platinum wire was heated in a mixture of dried carbonic oxide and oxygen it glowed intensely for some minutes, and complete combustion was found to have taken place between the two gases. No flame was visible round the wires.

DISCUSSION.

Mr. COWPER said that he could confirm Mr. Dixon's statements: on passing sparks through a dry mixture of CO and oxygen he had always noticed a blue glow around the wires, due to local action, but no explosion took place unless the gases had not been thoroughly dried.

Captain ABNEY inquired to what extent Mr. Dixon had heated the tubes before introducing both gases; it was well known that moisture condensed on the glass, which it was not easy to remove.

Dr. ARMSTRONG said that Mr. Dixon's observations appeared, like those of Langer and Mayer on the action of chlorine on platinum, to support the view he had put forward in a previous discussion, that probably it was necessary to distinguish between two forms of chemical action, the one occurring at high, the other at low temperatures. It was an important question whether the platinum played any part in the case under discussion; even without it, however, three things would still be present, since there would be CO, O_2, and O, whenever the spark passed.

Professor McLEOD asked whether Mr. Dixon had observed the deposition of a dark brownish substance near the electrodes when sparks were passed through dry CO_2. He called attention to the fact that chromic chloride was rendered soluble in water by a trace of chromous chloride as an illustration of the influence exerted by a third body.

Mr. DONKIN reminded the meeting of Sir B. Brodie's observations on the production of lower solid oxides of carbon when carbonic oxide was submitted to the action of the silent discharge in a Siemens tube.

Mr. DIXON said that he had heated his tubes above 100°, and had then introduced hot mercury; oxygen was next introduced and also the drying agent, and the wire was then heated to redness for some time. In his experiments he had not observed the formation of the deposit referred to. He had found that carbon monoxide was decomposed to the extent of only 0·5 per cent by sparking.

(To be continued.)

PHYSICAL SOCIETY.

June 13th, 1885.

Prof. GUTHRIE, President, in the Chair.

"*On the Winding of Voltmeters.*" By Profs. W. E. AYRTON and JOHN PERRY.

It is most important that voltmeters, ohmmeters, powermeters, and ergmeters should be so constructed that the percentage increase of resistance of their fine wire coils due to the heating effects of the currents passing through them should be as small as possible. The question arises as to whether such coils should be made of German silver wire or of copper, or partly of German silver and partly of copper wire, and how the diameter of the wire should vary in different parts of the coil; the authors have therefore been led to investigate the conditions that make this heating error a minimum with cylindrical coils of internal and external radii r_0 and r_1.

At a place whose distance from the axis is r, let the cross section of the wire be x, ρ the specific resistance of of the material; then assuming that $x = x_0 r^a$, $\rho = \rho_0 r^b$, $\rho r = \rho_0 r_0 r^c$, and that a current c in one spire of radius r produces a magnetic effect, KCr^d, on the suspended needle, they find that the heating error is proportional to

$$r_0 \rho_0 \frac{p^2}{(r_1^p - r_0^p)} \cdot \frac{n}{r_1^n - r_0^n} \cdot \frac{r_1^m - r_0^m}{m}$$

where $p=d-a+1$, $n=2+b-2a$, $m=2+1{\cdot}144b-4a$. The conditions that make this expression a minimum are worked out in the paper, the result being that with one of their magnifying spring solenoid instruments where $d=-1$, the values of a and b giving a minimum value are $a=0{\cdot}325$ and $b=-0{\cdot}5$, and since in practice b cannot be negative they conclude that $b=0$ and $a=0{\cdot}4$ give the best results, *i.e.*, that all the wire employed in the bobbin should be of copper, and the law of increase of cross section proceeding from the centre should be $x=x_0r^{0{\cdot}4}$. The actual waste of energy in the instruments is next considered, and lastly the authors show how to pass from a voltmeter with known winding, and whose maximum reading is P, to another of the same volume and shape whose miximum reading is to be P_2, and they conclude that as they have shown that the waste of energy is the same in both for their maximum readings, the resistances of the instruments must be proportional to the squares of P and P_2, or following the law already arrived at for a minimum error due to heating, the cross sections of the wires of the two instruments at similar places must be inversely proportional to P and P_2.

The employment of outside coils for voltmeters is considered, and it is shown that if we desire the same error in the two instruments due to heating when the outside resistance coils are of the same size and shape, it is necessary to have the same ratio between the resistance of the resistance coil and that of the magnetising coil in the two cases. To have a less or a greater error in the second case it is only necessary to use the equation—

$$e \text{ (the error)} = \frac{2+\text{F.V.}}{1+\text{F.V.}}$$

where F is a constant and V the volume of the German silver resistance coil. From this V may be determined, and the ratio $\frac{R_1}{R}$ of the resistances of the resistance coil and the magnetising coil is given by $\frac{R_1}{R}=\frac{F}{D}V$. where D is a constant which, like F, is obtained from experiments on the first instrument.

The diminution of the heating error by using much iron in the instrument so as to obtain the same magnetic action with a much smaller current is discussed, and experiments were shown to illustrate how such employment of iron introduced a permanent magnetism error and caused the indications of such an instrument on the lower part of the scale to be uncertain, and to depend upon whether measurements were being made with an increasing or a diminishing current.

"*On the Manner in which Light Affects the Resistance of Selenium and Sulphur Cells.*" By Shelford Bidwell.

In a communication made to the Society at its last meeting, the author had described a sulphur cell which behaved in all respects like a selenium cell when exposed to light. The action of this cell was supposed to be electrolytic, the sulphur containing a small quantity of sulphide of silver. If this were the case, the result of a current traversing the cell would be to deposit sulphur upon the anode, and as sulphur has an enormous resistance that of the cell would increase unless the sulphur thus deposited combined with the silver. It is this combination that is believed to be much facilitated by light, a supposition the author believed he had confirmed by direct experiment. Mr. Bidwell had also measured the resistance of a piece of selenium that was believed never to have been heated in contact with a metal. The specimen was crystallised by heating for some time in a glass mould, two opposite sides cleaned, and two pieces of tin-foil between which the resistance was measured pressed against them. In this way the specific resistance was found to be 2500 megohms, which is enormously higher than that of the selenium in the "cells," a fact tending to confirm the theory that the conduction in such cells is due to the electrolysis of the selenides of the metals forming the terminals produced in the "looking," and similar to that of the sulphur cell described above.

"*On the Error involved in Prof. Quinke's Method of Calculating Surface Tensions from the Dimensions of Flat Drops and Bubbles.*" By A. M. Worthington.

In a series of well-known papers, Prof. Quinke has recorded a large number of measures of flat drops and bubbles from which he has deduced the values of tensions for the free surface of a liquid and for the common surface of two liquids in contact. The numerical results obtained in this way exceed those obtained from observations upon the rise in capillary tubes, which Prof. Quinke attributes chiefly to the fact that in the latter case the edge angle is not zero. Mr. Worthington, however, shows that the surface tensions obtained by Prof. Quinke with flat drops are too high, this arising from his having assumed that the drops were flat at the vertex. The error thus introduced is very considerable, amounting in most cases to as much as 10 per cent of the whole value, and upon its being duly corrected the values obtained do not appreciably exceed those obtained with capillary tubes.

"*On a Comparison between the Mercury Standards of Resistance issued by M. Mascart with those of the British Association.*" By R. T. Glazebrook.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

Note.—All degrees of temperature are Centigrade unless otherwise expressed.

Comptes Rendus Hebdomadaires des Séances, de l'Académie des Sciences. Vol. c., No. 19, May 11, 1885.

Limit of the Combination of Magnesium and Potassium Bicarbonates.—R. Engel.—The decomposition of the præ-formed double salt suspended in water increases at a given temperature with the pressure of the carbonic acid. This increase at 16° is as follows:—At 1 atmosphere, 6·25; at 2, 7·1; at 4, 7·95; and at 6 atmospheres, 8·3.

A Hydrochlorate of Chromous Chloride.—M. Recoura.—Into a very concentrated solution of chromous chloride there is passed a current of dry hydrochloric acid absolutely free from oxygen. The containing vessel is refrigerated to prevent the rise of temperature due to the hydrochloric acid passing into a state of solution. After some time there is formed a deep blue crystalline deposit. The compound formed has the composition—

$$\text{HCl, 3(CrCl),13HO.}$$

It is a very fine powder of a bluish white colour, stable at 0°, but undergoing decomposition at 20°.

Calorimetric Study of the Effects of Tempering and of Cold-beating upon Cast-Steel.—M. Osmond.—The author examines whether the modifications in the physical properties of iron and steel due to tempering and cold-beating are due to thermic modifications, and for this purpose he measures the heat liberated in one and the same reaction by the same metal in different physical conditions. He finds that the effect of tempering, like that of cold-beating, is manifested by an increase of heat which augments in the same manner as the proportion of carbon.

A New Instrument called the Hæma-Spectroscope. M. de Thierry.—The author has constructed a specially modified instrument for the detection of infinitesimal traces of blood in water, urine, &c., and for determining its presence in spots on linen, stuffs, wood, metals. The process is founded on the principal optical properties of oxy-hæmoglobine and of reduced globine, which give, the former two absorption-bands between the D and E rays of the spectrum, and the other a single band known as Stokes's band, situate between the two former.

On Pathological Urines.—A. Villiers.—The author contends, in opposition to MM. Bouchard and Pouchet, that alkaloids exist not in normal but merely in pathological urine.

No. 20, May 18, 1885.

Production of Induction Sparks of High Temperatures and their Application in Spectroscopy.—Eug. Demarçay.—The author has shown in a former communication that the spectra of the electric arc may be obtained by employing the induction spark yielded by a bobbin with thick inductor and induced wires. He now finds that the same spectra may be obtained by means of bobbins of ordinary thin wire. Still, though the same spectra are obtained, the quantity of light produced, and consequently the brilliance of the spectrum, are much less.

Simultaneous Action of Oxygen and of the Hydracids upon Selenurea.—A. Verneuil.—In a former paper the author describes the formation of oxy-tri-selenurea hydrochlorate. On a more prolonged action of the air and the acid a compound is produced of the composition $(C_2N_2H_4Se_2)_2Cl_2$. Hydrobromic acid acts upon selenurea in a corresponding manner.

Composition and Combustion Heat of a Coal from the Ruhr.—M. Scheurer-Kestner.—A paper of merely local interest.

Revue Universelle des Mines, de la Metallurgie, &c.,
March and April, 1885.

This issue contains no chemical matter except a popular summary of the manure manufacture, in the form of a lecture delivered at Berlin by Dr. Cohn. We find here the most remarkable statement that coprolites are found in abundance in Devonshire.

Cosmos les Mondes.
New Series, No. 15, May 11, 1885.

This issue contains no chemical memoirs.

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END OF VOLUME LI.

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